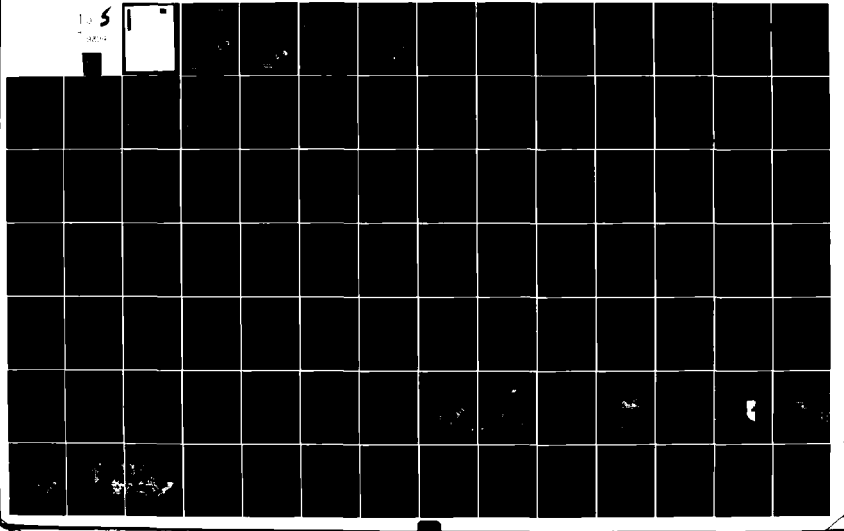
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The purpose of this study is to investigate the water and related land resource problems in the Bassett Creek watershed and to development the most suitable plan to solve them. The project would provide protection against a flood having a 100-year frequency. Also included in the plan are recreational bikeways and hiking trails along the creek in Minneapolis.

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APPENDIX 1

TECHNICAL REPORT

SECTION A. THE STUDY AND REPORT

SECTION B. RESOURCES AND ECONOMY OF STUDY AREA

SECTION C. PROBLEMS AND NEEDS

SECTION D. PLAN FORMULATION

SECTION E. THE SELECTED PLAN

SECTION F. IMPACTS OF THE SELECTED PLAN

SECTION G. DIVISION OF PLAN RESPONSIBILITIES

SECTION H. DESIGN CONSIDERATIONS AND DETAILED COST ESTIMATES

SECTION I. FLOOD PLAIN REGULATION

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SECTION A

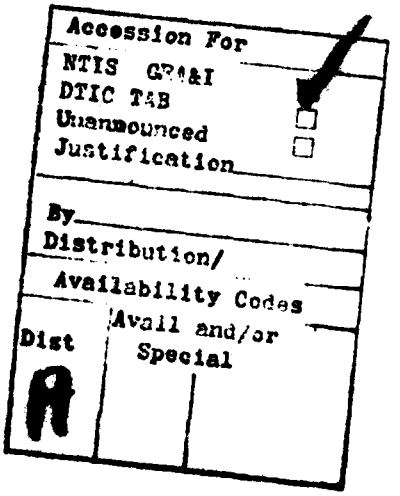
THE STUDY AND REPORT

THE STUDY AND REPORT

Table of Contents

Item	Page
PURPOSE AND AUTHORITY	A-1
SCOPE OF THE STUDY	A-2
STUDY PARTICIPATION AND COORDINATION	A-2
THE REPORT	A-3
PRIOR STUDIES AND REPORTS	A-4





SECTION A

THE STUDY AND REPORT

PURPOSE AND AUTHORITY

The purpose of this study is to investigate the water and related land resource problems in the Bassett Creek watershed and to develop the most suitable plan to solve these problems. Economic, environmental and social feasibility are major factors considered in selecting a plan and were, therefore, investigated in detail. The recommendations of this study are presented in the main report.

This report is submitted in partial compliance with the following resolution by the Committee on Public Works of the United States House of Representatives, adopted 24 September 1970:

> "Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on the Mississippi River between Coon Rapids Dam and the mouth of the Ohio River, submitted in House Document No. 669, 76th Congress, 3rd Session, and other pertinent reports, with a view to determining the advisability of modifying the recommendations contained therein at the present time, with particular reference to providing improvements in the interest of flood control and allied purposes in the Bassett Creek watershed at and in the vicinity of Minneapolis, Minnesota."

Further authority for this report is provided by the resolution of the Committee on Public Works of the United States Senate, adopted 7 April 1962:

> "Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the report of the Chief of Engineers on the Mississippi River between Coon Rapids Dam and the mouth of the Ohio River, published as House Document Numbered 669, Seventy-sixth Congress, third Session with a view to determining the advisability of modifying the recommendations contained therein at the present time with specific reference to providing improvements in the interest of flood control, major drainage, and allied purposes on the Bassett Creek watershed at and in the vicinity of Minneapolis, Minnesota."

SCOPE OF THE STUDY

This study assesses the water and related land resource problems in the Bassett Creek watershed.

The Bassett Creek watershed is located within the Minneapolis-St. Paul metropolitan area. The watershed is entirely within Hennepin County and contains portions of nine municipalities: Crystal, Golden Valley, Medicine Lake, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale and St. Louis Park. The creek is an aesthetic meandering stream which enhances residential development and serves as a setting for parks, walkways and recreational areas. In several areas of the watershed, wetlands and natural areas remain amidst the rapidly urbanizing area.

The study reviews the water resource and related land resource problems and the potential solutions of these problems for the entire Bassett Creek watershed. The study evaluates the engineering, economic, environmental and social aspects of the flood control alternatives for Bassett Creek. A continuous public involvement and public participation program has been utilized throughout the study to identify the plan which will meet flood damage reduction needs and is responsive to the desires of the affected public. All reasonable alternative plans to solve the area's water resource problems were considered and the several plans were studied in some detail including cost and benefit estimates. The selection of the most feasible plan was made after considering all factors including those expressed by concerned citizens, concerned Federal and State agencies, and local interests. These studies were made only in sufficient depth and detail to permit plan selection and to determine plan feasibility.

STUDY PARTICIPATION AND COORDINATION

The Corps of Engineers had the primary responsibility for conducting the overall study, formulating the plan, consolidating information from other agencies and local interests, and preparing the report. Federal

agencies providing advice and input to the study include the Fish and Wildlife Service, the Department of Housing and Urban Development, the Department of Health, Education and Welfare, the Department of Commerce, the Department of Agriculture, the U. S. Geological Survey, the Department of Transportation, the Bureau of Outdoor Recreation, the Environmental Protection Agency, the U. S. Soil Conservation Service. Close liaison was maintained with state agencies, particularly the Minnesota Department of Natural Resources and the Minnesota Department of Highways.

Realizing that the potential for flooding along the creek is increasing as urbanization of the watershed continues, local interests adopted a Joint Powers Agreement and formed the Bassett Creek Flood Control Commission in 1969. The Joint Powers Agreement provides the basis for the cooperation between the nine municipalities in the investigation, planning and implementation of flood control measures. The Commission was instrumental in providing for the coordination and cooperation of the local interests.

As a result of the Bassett Creek Flood Control Commission's coordination efforts, several public meetings were held in the municipalities in the Bassett Creek watershed during this study. At these meetings, the current and future flood problems were discussed and the views and objectives of interested citizens and organizations were solicited. During the later stages of this study, features of the various flood control alternatives as they applied to each municipality and to the watershed as a whole were discussed at public meetings.

THE REPORT

In the interest of clarity and presentation, the report has been arranged into a main report with two appendices. The main report is a general non-technical presentation of the feasibility study of water and related land resources in the Bassett Creek watershed. This basic document presents a broad view of the overall study and is intended for the general reviewer. Included in the main report are plan formulation

selection procedures, division of project responsibilities between federal and non-federal interests and recommendations for implementing the selected plan.

Appendix 1 is a technical report providing greater detail of the basic information, plan formulation and selection, and the determination of responsibilities for the selected plan. Following the same general outline as the main report, it is the key document for the technical reviewer.

Appendix 2 contains pertinent correspondence affecting the coordination with federal and state agencies and local interests and a summary of public involvement activities conducted during the study.

PRIOR STUDIES AND REPORTS

Several previous studies of the existing and potential flood and water resource related problems in the Bassett Creek watershed have been completed. These studies and reports provide valuable information regarding the water resource problems and needs of the area and recommended solutions to meet those needs. Studies of the watershed include:

a. A preliminary report on the storm water drainage problems in the watershed and a plan to provide protection from a 10-year frequency storm was prepared by a consulting engineering firm in 1961. The report recommended storage sites and channel improvements throughout the watershed to provide that protection.

b. A review survey report was completed by the St. Paul District Corps of Engineers on 25 November 1966, in response to a resolution adopted by the United States Senate, Committee on Public Works, 7 April 1962. This study indicated that an economically feasible project could be developed to provide flood protection. The study recommended that in the absence of the required assurances of local cooperation, federal participation in a flood control plan was not warranted at that time.

c. A plan of survey for flood control and related purposes prepared for Bassett Creek on 6 May, 1963, was revised 5 October 1970, by the St. Paul District Corps of Engineers in accordance with a Senate Committee of Public Works resolution adopted 7 April 1962, and by a House Committee on Public Works resolution adopted 24 September 1970. The revised plan of investigation in cooperation with the Bassett Creek Flood Control Commission was presented and approval was recommended.

d. A Watershed Management Plan for Bassett Creek was prepared and adopted by the Bassett Creek Flood Control Commission on 18 May 1972. The plan delineated the 100-year frequency flood plain and established a "management envelope" or elevation below which future development would be restricted. The management of this "envelope" will preserve the various options available for flood control until a plan which meets the needs of the public can be implemented.

e. The Upper Mississippi River Comprehensive Basin Study was completed in July, 1972. This study prepared under the supervision of the Upper Mississippi River Basin Coordinating Committee presents data for a framework program for development and management of water and related land resources of the Upper Mississippi River Basin which includes the Bassett Creek watershed.

f. Comprehensive land use zoning and drainage plans have been prepared and adopted by most of the communities in the Bassett Creek watershed. In addition, all of the communities in the watershed are in the process of preparing flood zone ordinances in accordance with the 1969 Minnesota Flood Plain Management Act.

g. A preliminary Feasibility Report for Flood Control for Bassett Creek was prepared by the Bassett Creek Flood Control Commission in September, 1974. The report summarized current and potential problems and needs in the Bassett Creek watershed and evaluated

and discussed the results of a preliminary examination of the alternatives for flood control in the Bassett Creek watershed. The report acquainted the public with information obtained and conclusions drawn during the feasibility study. The feasibility report made recommendations regarding the need for and the extent of further studies regarding flood control on Bassett Creek.

h. An Archaeological Reconnaissance Report for the Bassett Creek watershed flood control area was completed in November, 1975 by the St. Paul District Corps of Engineers. The report inventories archaeological potential in the Bassett Creek flood control area and makes recommendations for further archaeological investigations during subsequent planning stages of the proposed project.

i. A Level B Study is currently being conducted in the seven-county metropolitan area. The study is a reconnaissance level evaluation of the water and related land resources in the metropolitan area. The study will identify water and related land resource problems and needs as perceived by area residents and will develop alternative measures to satisfy those problems and needs consistent with their attitudes and preferences. Flooding along metropolitan area streams, the installation of fish barriers, and the protection of wetlands and flood plains are among the problems identified by the Level B Study Team. Because the Bassett Creek Watershed has been the subject of intensive study efforts, the Level B study will monitor the planning process in the Bassett Creek Watershed as input in recommended alternative measures for other streams in the area.

SECTION B

RESOURCES AND ECONOMY OF STUDY AREA

RESOURCES AND ECONOMY
OF STUDY AREA

Table of Contents

Item	Page
INTRODUCTION.	B-1
ENVIRONMENTAL SETTING AND NATURAL RESOURCES	B-2
CLIMATE.	B-2
TOPOGRAPHY.	B-4
SOILS	B-4
GEOLOGY.	B-6
WATER SUPPLY	B-8
WATER QUALITY.	B-9
AIR QUALITY	B-11
VEGETATION.	B-12
Flood Plain Forest	B-16
Upland Hardwood Forest	B-16
Marsh.	B-17
Open Water	B-18
Residential.	B-20
Industrial and Commercial	B-21
FISH AND WILDLIFE	B-21
HISTORICAL AND ARCHAEOLOGICAL RESOURCES	B-25
RECREATION.	B-26
PULBIC HEALTH AND SAFETY	B-33
HUMAN RESOURCES.	B-37
POPULATION CHARACTERISTICS	B-37

Page

EDUCATION B-42

OCCUPATIONS B-44

EMPLOYMENT. B-46

INCOME B-52

DEVELOPMENT AND ECONOMY B-57

PRESENT DEVELOPMENT. B-57

TRANSPORTATION B-58

PRESENT LAND USE. B-58

FUTURE LAND USE B-59

List of Tables

MEAN MONTHLY TEMPERATURES AND PRECIPITATION B-3

GENERALIZED GEOLOGIC SECTION UNDER THE BASSETT CREEK WATERSHED B-7

WATER QUALITY STANDARD FOR BASSETT CREEK B-9

STATE AMBIENT AIR QUALITY STANDARDS B-13

MAJOR LAKES AND PONDS IN THE BASSETT CREEK WATERSHED . . . B-19

HISTORCIAL, ARCHITECTURAL, AND ARCHAEOLOGICAL SITES IN THE VICINITY OF THE BASSETT CREEK WATERSHED. . . B-26

EXISTING REGIONAL RECREATION FACILITIES. B-28

METROPOLITAN RECREATION OPEN SPACE SYSTEM B-29

RECREATIONAL OPPORTUNITIES AT LAKES WITHIN THE WATERSHED. B-35

SUMMARY OF RECREATION RESOURCES IN BASSETT CREEK WATERSHED B-36

Page

HISTORIC AND PROJECTED POPULATION B-41

1970 EDUCATION STATISTICS B-43

1970 OCCUPATION STATISTICS B-45

HISTORIC AND PROJECT EMPLOYMENT BY OCCUPATION FOR THE MINNEAPOLIS-ST. PAUL SMSA B-47

1970 EMPLOYMENT STATISTICS B-48

HISTORIC AND PROJECTED EMPLOYMENT BY INDUSTRY FOR THE MINNEAPOLIS-ST. PAUL AREA B-50

COMPARISON OF HISTORIC AND PROJECT EMPLOYMENT FOR MINNEAPOLIS-ST. PAUL SMSA B-51

EMPLOYMENT FORECASTS B-53

1970 PERSONAL INCOME STATISTICS B-54

1970 FAMILY INCOME STATISTICS B-55

HISTORIC AND PROJECTED ECONOMIC DATA FOR THE MINNEAPOLIS-ST. PAUL SMSA. B-56

PRESENT AND FUTURE LAND USE IN THE BASSETT CREEK WATERSHED B-60

PRESENT AND FUTURE LAND USE IN THE 100-YEAR FLOOD PLAIN B-60

Plates

Plate No.	
B-1	LOCATION
B-2	WIND ROSE
B-3	AIR QUALITY SAMPLING STATIONS
B-4	POPULATION DENSITY
B-5	EXISTING LAND USE
B-6	FUTURE LAND USE

SECTION B

RESOURCE AND ECONOMY OF THE STUDY AREA

The original settlement of the Minneapolis-St. Paul metropolitan area began in 1820 by the establishment of the Fort St. Anthony Military Reservation (renamed Fort Snelling in 1825) at the confluence of the Minnesota and the Mississippi Rivers. The Minnesota River and the Mississippi River provided the transportation base for the future industrial development of the area. In addition, the Mississippi River provided a central source of power for the early industrial development in the area. The flour milling and lumbering industries and their supportive activities established th Minneapolis-St. Paul metropolitan area as the regional trade, financial and transportation center of the upper midwest. Although lumbering is no longer a viable industry in the metropolitan area, the food processing industries along with printing and publishing, the manufacture of precision instruments, computers, electronic equipment, electrical machinery and transportation machinery are important to the economy of the area. At the present time, no single industry or group of industries dominate the economy of the Minneapolis-St. Paul metropolitan area.

Among its important resources are the educational facilities available to the people of the Minneapolis-St. Paul metropolitan area. There are thirteen colleges and universities, six junior colleges and seven area vocational-technical schools in the immediate area. In addition, the University of Minnesota hospitals, their research facilities and medical schools have gained world renown.

There is a high degree of flexibility in the location of residential and commercial development in the Minneapolis-St. Paul metropolitan area because of a diversified transportation system. Two major interstate highways serve the metropolitan area from out-state areas and an outer interstate ring circling Minneapolis and St. Paul provides an efficient link between suburban areas. Public transportation is provided by an extensive network of regular and express bus service routes which are

operated by the Metropolitan Transit Commission. The Twin Cities area is also served by six major railroads, eight airlines, an extensive trucking system, and barge service on the Mississippi and Minnesota Rivers.

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

Bassett Creek drains approximately 42 square miles and originates upstream of Medicine Lake in the sparsely developed areas of the City of Plymouth. The creek flows east through Golden Valley, Crystal and Minneapolis to the Mississippi River, the last portion of which is through a 1-1/2 mile conduit. The creek enters the Mississippi River less than one mile upstream of the Upper St. Anthony Falls Lock and Dam near River Mile 855. Between Medicine Lake and its confluence with the Mississippi River two branches, the North Branch and Sweeney Lake Branch, join the main stem of Bassett Creek. The North Branch drains portions of Plymouth, New Hope and Crystal, and joins the main stem immediately upstream of Highway 100. The Sweeney Lake Branch drains portions of the St. Louis Park and Golden Valley and joins the main stem in Theodore Wirth Park near Golden Valley Road. A map of the watershed is shown on Plate B-1.

CLIMATE

The climate of the area is moderate, characterized by large seasonal variations in temperature, normally sufficient rainfall for crops, and moderate snowfall. The summers are warm and moderately humid, with short periods of hot, very humid weather occasionally occurring during the summer months. The winters are usually cold and moderately humid.

Intense summer thunderstorms are common and are occasionally accompanied by tornado activity. A record summer storm recorded at the Minneapolis-St. Paul International Airport occurred in July 1951, during which a maximum wind velocity of 92 miles per hour was recorded and 2.93 inches of rainfall fell in a 6-hour period. Five tornadoes were reported in Hennepin County during this same storm period. Winter storms with high

winds causing severe blizzard conditions occur occasionally. The worst winter storm of record occurred on 10-11 January 1975, with winds up to 60 mph and 7 inches of snow in a 24-hour period were recorded in the vicinity of the watershed. The record 24-hour snowfall at the Minneapolis-St. Paul International Airport was 16.2 inches on 12 November 1940.

The mean annual temperature for the Bassett Creek watershed is 44°F. The mean monthly temperature varies from 12°F in January to 73°F in July and are shown in Table 1. Extreme temperatures recorded were a high of 108°F on 14 July 1936, and a low of -34°F on 1 January 1936. The average date for latest occurrence of freezing temperatures is April 30, while the average date for the first autumn frost is about October 13. The average frost-free period is approximately 166 days.

Annual precipitation for the Bassett Creek watershed averages 26 inches and has ranged from a low of 11.5 inches in 1910 to a high of 40.1 inches in 1911. The mean monthly precipitation varies from 4.0 inches in June to 0.7 inches in January. The mean monthly precipitation is shown in Table 1. About 70 percent of the precipitation occurs during the growing season. Snowfall averages 44 inches annually and represents about 17 percent of the total precipitation. Extreme snowfall records range from 88.9 inches during the 1950-51 season to 14.2 inches during the 1930-31 season.

TABLE 1

MEAN MONTHLY TEMPERATURES AND PRECIPITATION

Month	Temperature °F	Precipitation (inches)
January	12	.7
February	16	.8
March	27	1.5
April	44	2.0
May	57	3.0
June	67	4.0

TABLE 1 (continued)

Month	Temperature °F	Precipitation (inches)
July	73	3.2
August	70	3.1
September	60	2.5
October	49	1.6
November	31	1.4
December	17	1.3

Source: United States Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service.

The wind-rose in Plate B-2 indicates that the prevailing winds are from the northwest and southeast directions. Mean monthly wind velocity ranges from about 9 miles per hour during August to about 12 miles per hour during April.

TOPOGRAPHY

The topographic relief of the Bassett Creek watershed is about 210 feet. The boundary of the watershed rises from Elevation 980 west of Parkers Lake to Elevation 1010, west of Schmidt Lake. From this point east, the northern and southern boundaries drop to approximately Elevation 800 where the creek enters the Mississippi River. Extensive urbanization has greatly altered the natural topography of the watershed, however, in the remaining undeveloped portions of the watershed, drainage patterns are generally not well defined and the areas are interspersed with marshland and irregular hills and knolls. Remnants of these marshlands are evident in developed portions of the watershed along the major drainageways.

SOILS

The surface soils throughout much of the Bassett Creek watershed are principally of the Hayden series and are predominantly found in two major associations. These associations are the Hayden-Cordova-Peaty Muck

Association and the Hayden-Peaty Muck Association. The Hayden soils make up from 40 to 50 percent of these associations. The Hayden soils are generally well-drained and have a surface layer of grayish loam or clay loam and a subsoil of slight clay loam. They are moderately permeable and have high available moisture capacity.

Of the Hayden-Cordova-Peaty Muck Association, the Hayden soils make up about 40 percent, Cordova soils about 10 percent, Peaty Muck soils about 5 percent and minor soils about 45 percent of the association. The poorly drained Cordova soils in swales and on flats have a surface layer of black silty clay loam and a subsoil of clay loam. They have a high available moisture capacity and a moderately slow permeability. The very poorly drained Peaty Muck soils in depressions consist of deep organic materials. The important minor soils in this association include the very poorly drained Glencoe soils in depressions, the poorly drained Hamel, Dundas, Minnetonka and Shields soils in drainageways and on the flats, and the moderately well-drained Dalbo soils on the low knolls and hills.

Of the Hayden-Peaty Muck Association, the Hayden soils comprise about 50 percent, the Peaty Muck soils about 10 percent, and minor soils about 40 percent of the association. The very poorly drained Peaty Muck soils consist of deep organic materials. They have a very high available moisture capacity and a low fertility. The minor soils in this association include the Glencoe, Cordova, Dundas, Hamel, Nessel, and Dalbo soils. The very poorly drained Glencoe soils are characteristics of the drainageways. The moderately well-drained Nessel and Dalbo soils occur in low knolls and on the crowns of the larger hills.

In the vicinity of Parkers Lake in the western portions of the Bassett Creek watershed, the surface soils tend to be of the Estherville series. The Estherville soils have a surface layer of very dark brown sandy loam and a subsoil of dark yellowish brown sandy loam. Calcareous sand and gravel occur at a depth of 14 to 24 inches.

The surface soils downstream of Cedar Lake Road in Minneapolis are the Hubbard series which are common in the Mississippi River Valley Train.

The Hubbard soils formed under prairie vegetation, have a dark surface horizon that grades into a bright brown colored subsoil. Larger medium sands are typical of the Hubbard profile.

GEOLOGY

The Bassett Creek watershed is located in the northwestern portion of a bedrock structure underlying Minneapolis-St. Paul metropolitan area, which has a gentle slope to the southeast. The generalized geologic section is presented in Table 2. The bedrock is overlain by a layer of glacial drift which tapers from over 200 feet thick in the western portion of the watershed to approximately 25 feet thick in the southeastern portion of the waterhsed in Minneapolis. Generally, there is no uniform relationship between the existing surface topography and the bedrock structure. The watershed is underlain by up to 40 feet of Plattesville shales and limestones in the southeast portion of the watershed and along the southern boundary of the watershed. As shown in the generalized geologic section, the remainder of the watershed is underlain by up to 100 feet of St. Peter Sandstone except in the northwest portions and in the extreme eastern portions where preglacial Mississippi River valleys cut through the sandstone and into the Prairie-du-Chein Dolomite. Two rift valleys interrupt the tapered glacial drift and cut deeply into the bedrock. One extends though the watershed in a line from Crystal Lake through Wirth Lake. It cuts deeply into the Prairie-du-Chien Dolomite and is filled with up to 250 feet of drift. The other extends through the watershed along a line from Lowry Avenue and the Mississippi River through the intersection of Highway 55 and Lyndale Avenue. It cuts through the Prairie-du-Chien and into the Jordan Sandstone and is filled with 250 feet of drift.

The watershed is underlain by five major bedrock aquifers: the St. Peter Sandstone, Prairie-du-Chien Dolomite, Jordan Sandstone, Franconia-Galesville Sandstones and the Mt. Simon-Hinckley Sandstones. The aquifer characteristics of these formations are described briefly in Table 2. In addition, there are numerous aquifers in the glacial drift. Some groundwater from the glacial drift and the St. Peter aquifer discharges into Bassett Creek. The remaining aquifers discharge into the Minnesota

System	Formation and Member	Approximate Thickness (feet)	Aquifer Characteristics
Pleistocene	Glacial Drift	25-200	Small to moderate quantities of water available from same and gravel lenses.
Ordovician	Platteville Formation and Glenwood Member	0-40	Small quantities of water available from fractures, fissures and solution cavities.
	St. Peter Sandstone	0-150	Small to moderate quantities of water available
Cambrian	Prairie-du-Chien Dolomite	130-180	Large quantities of water available.
	Jordan Sandstone	90	
	St. Lawrence Formation	50	
	Franconia Formation Reno & Mazomanie Members Tomah Member Birkmose Member Woodhill Member	190	Small to moderate quantities of water available from sandstone beds.
	Dresbach Formation Galesville Member Eau Clair Member Mt. Simon Member	275	
Precambrian	Hinckley Sandstone	220	Moderate quantities of water available.
	Red Clastic Series	More than 1,000	

Source: United States Department of the Interior, Geological Survey

TABLE 2--GENERALIZED GEOLOGIC SECTION UNDER THE BASSETT CREEK WATERSHED

and the Mississippi Rivers, the movement of which is complicated by the intersecting rift valleys. The groundwater in all the major aquifers and glacial drift is of the calcium bicarbonate type. The concentrations of dissolved solids in the glacial drift range from 300 parts per million to 350 parts per million in the northern and southern margins. The concentrations of dissolved solids in the major bedrock aquifers range from approximately 225 ppm in the Franconia-Galesville to over 450 ppm in the St. Peter and Prairie-du-Chien aquifers.

WATER SUPPLY

The existing average daily consumption of water for municipal and industrial pruposes in the Minneapolis-St. Paul metropolitan area has been estimated to be approximately 327 million gallons per day. Of this 327 million gallons per day, approximately 40 percent is obtained from surface water supplies and 50 percent is obtained from groundwater aquifers. Studies of the water requirements of the metropolitan area have shown that by the year 2010, the total water demand could double. The increased water use in the metropolitan area has created some problems, including general lowering of some lake levels, decline in the potentiometric head of the major aquifers, and the general concern regarding the adequacy of the existing sources, especially during the period of drought. At the present time, a coordinated effort to develop a detailed plan for the management, monitoring and development of the overall water resource system in the metropolitan area has not been made.

The City of Minneapolis withdraws approximately 77 million gallons of water per day from the Mississippi River for municipal and industrial purposes. In addition, the City of Minneapolis supplies Golden Valley, Crystal, and New Hope with water. Plymouth, Robbinsdale, Minnetonka, St. Louis Park and Medicine Lake obtain their water supplies from the Prairie-du-Chien Jordan or the Mt. Simon-Hinckley bedrock aquifers. The dependence on these sources for municipal and industrial supplies is not expected to change with increased future demand.

In the extreme western portions of the Bassett Creek watershed, some residents still obtain their domestic water supplies from private

supply wells. The respective municipal supplies either presently serve or are presently scheduled to serve these areas in the near future. It can, therefore, be expected that within the forseeable future, the domestic water supply throughout the watershed will be dependent upon municipal water supply systems.

WATER QUALITY

The Minnesota Pollution Control Agency (MPCA) has classified Bassett Creek in the Fisheries and Recreation category (Category 2) in the MPCA's Rules and Regulations (Minn. Reg. WPC 14). The Fisheries and Recreation category is further broken down into Class A, B and C waters based on a required range or limit of designated water quality parameters. Bassett Creek is in the B class and the overall standard classification for the stream is referred to as 2B. The 2B classification requires water of adequate quality to propagate and maintain both sport and commercial fishes as well as aquatic recreation of all kinds including swimming.

The water quality parameters included in the 2B classification include dissolved oxygen, temperature, ammonia, chromium, copper, cyanide, oil, pH, phenols, turbidity, fecal coliform and radio-active materials. Table 3 indicates the limits of these water quality parameters according to Minn. Reg. WPC 14.

TABLE 3

WATER QUALITY STANDARD FOR BASSETT CREEK

Parameter	Limit
Dissolved Oxygen	not < 6 mg/1 April 1-May 30
	not < 5 mg/1 any other time
Temperature	5°F above natural[1] - streams
	3°F above natural[1] - lakes
Ammonia (N)	1 mg/1
Chromium (Cr)	0.05 mg/1
Copper (Cu)	0.01 mg/1
Cyanides	0.02 mg/1
Oil	0.5 mg/1
pH	6.5 - 9.0

TABLE 3 (continued)

Parameter	Limit
Phenols	0.01 mg/1
Turbidity	25 Jackson Units
Fecal coliform	200/100 ml of sample
Radio-active material	Not to exceed the lowest concentration permitted by the authority having control over their use.

[1]Based on monthly average of the maximum daily temperature, except in no case shall it exceed the daily average temperature of 89°F.

Source: Minnesota Pollution Control Agency, Rules and Regulations, WPC 14, October 4, 1973.

A limited amount of water quality data is available for the Bassett Creek watershed. The Minnesota Pollution Control Agency (MPCA) operated two continuous water quality monitoring stations on Bassett Creek from 1960 to 1965. In 1972, the Bassett Creek Flood Control Commission initiated a water quality monitoring program for Bassett Creek as well as for the major lakes and ponds in the watershed. The water quality monitoring data collected during the first year indicated that the creek did not meet the MPCA standards in the summer months. Later results of the water quality monitoring program on Bassett Creek have indicated seasonal variations in sampling parameters, with the summer months demonstrating increased fecal coliform counts not meeting 2B standards.

The water quality of Medicine Lake, Sweeney Lake, Twin Lake, Wirth Lake and Parkers Lake, the five major lakes in the watershed, provides valuable information concerning biological, chemical and physical conditions of these lakes. The Bassett Creek Flood Control Commission has collected water quality data for the five major lakes and also for several ponds within the watershed.

Summarizing the available lake quality data, Twin Lake has the lowest biological productivity and could be termed the least eutrophic. Sweeney Lake has the second lowest biological productivity and is second to Twin Lake in water transparency. Past data shows that the biological productivity of Medicine Lake has been increasing at a rapid rate during the last thirty years. The overall state of eutrophication of Medicine Lake does, however, appear to be near optimum for fish production. Parkers Lake has average chlorophyll concentrations similar to Sweeney Lake, but the transparency is lower, indicating that suspended inorganic material may be contributing to the turbidity. The lake monitoring program indicated that in Wirth Lake, decreased water transparency due to algae production could sufficiently reduce the aesthetic value of the lake for park and recreation use. Wirth Lake had the highest sustained chlorophyll concentrations as well as the highest primary production and the lowest secchi disc reading of the five lakes. Based on this data, Wirth Lake could be termed the most eutrophic.

The quality of the ground water in the watershed is generally good. The ground water ranges from moderately hard to hard with high iron concentrations. Recognized sources of ground water pollution include septic tank and cesspool seepage and industrial discharges. Infrequent occurrences of localized contamination of the glacial drift aquifers and uppermost bedrock aquifers have been noted.

AIR QUALITY

Air quality information is available from four air quality sampling stations in the vicinity of the watershed. There are air quality sampling stations in Wayzata and St. Louis Park, which are representative of the western and central portions of the watershed. Minneapolis has numerous stations located around the central portion of the city and two of these stations provide data representative of the eastern portion of the watershed. The general location of the four air quality sampling stations are shown on the map in Plate B-3. The sampling stations are referred to as "high volume samplers" and collect information using wet and dry

techniques which involve the use of various filtering methods as well as solution chemistry. Results from the various sampling stations are analyzed in detail at the laboratory of the Minnesota Pollution Control Agency.

The air quality monitoring parameters are grouped into primary and secondary standards by the Minnesota Pollution Control Agency (MPCA). The primary air quality standards are air contamination levels above which health hazards may be produced. Secondary standards are levels desirable for protection of the public welfare from any adverse effects including injury to crops, property, sensory impairment or hazards to air and ground transportation. Table 4 lists the parameters of the State Ambient Air Quality Standards (Minn. Reg. APC 1).

One index used by the MPCA is the Air Pollution Index. It is derived from five pollutants; sulphur dioxide, total oxidants, carbon monoxide, nitrogen dioxide and dust (suspended particulates referred to as the coefficient of haze). The index obtained is a relative number which is significant by comparing it with previous index numbers recorded here or any other city using the same index.

The air quality standards established by the MPCA for particulate matter were not met at one of the sampling stations during 1974. The St. Louis Park station recorded a secondary violation, exceeding the standard annual geometric mean of 60 micrograms per cubic meter by 2 micrograms per cubic meter.

VEGETATION

Natural vegetation in the Bassett Creek watershed and vicinity includes portions of the Eastern Deciduous Forest and Temperate Grassland Biomes. The plant communities of Küchler and the wetland types recognized by the

TABLE 4

STATE AMBIENT AIR QUALITY STANDARDS

Pollutant/Air Contaminant	Concentration	Remarks
(1) Hydrogen Sulfide (primary standards)	0.05 ppm by volume (70.0 micrograms per cubic meter)	1/2 hr. average not to be exceeded over 2 times per yr.
	0.03 ppm by volume (42.0 micrograms per cubic meter)	1/2 hr. average not to be exceeded over 2 times in any 5 consecutive days
(2) Photochemical Oxidants (primary and secondary standards)	0.07 ppm by volume (130 micrograms per cubic meter)	maximum 1 hr. concentration not to be exceeded more than once per yr.
(3) Carbon Monoxide (primary and secondary standards)	9 ppm by volume (10 milligrams per cubic meter)	maximum 8 hr. concentration not to be exceeded more than one per yr.
	30 ppm by volume (35 milligrams per cubic meter)	maximum 1 hr. concentration not to be exceeded more than once per yr.
(4) Hydrocarbons (primary and secondary standards)	0.24 ppm by volume (160 micrograms per cubic meter)	maximum 3 hr. concentration (6 to 9 a.m.) not to be exceeded more than once per yr. corrected for methane
(5) Sulfur Oxides (primary and secondary standards)	0.02 ppm by volume (60 micrograms per cubic meter)	maximum annual arithmetic means
	0.01 ppm by volume (260 micrograms per cubic meter)	maximum 24 hr. concentration not to be exceeded more than once per yr.
(6) Particulate Matter (primary standard)	75 micrograms per cubic meter	maximum annual geometric mean
	260 micrograms per cubic meter	maximum 24 hr. concentration not to be exceeded more than once per yr.
Particulate Matter (secondary standard)	60 micrograms per cubic meter	maximum annual geometric mean
	150 micrograms per cubic meter	maximum 24 hr. concentration not to be exceeded more than once per yr.

TABLE 4 (cont.)

Pollutant/Air Contaminant	Concentration	Remarks
(7) Nitrogen Oxides (primary and secondary standards)	0.05 ppm (100 micrograms per cubic meter)	maximum annual arithmetic mean

Source: Minnesota Pollution Control Agency, Rules and Regulations, Chapter 1, APC 1, April 13, 1972.

Bureau of Sports Fisheries and Wildlife are evident.

Prior to settlement, the watershed was covered by two major cover types. From the Mississippi River to Medicine Lake, the watershed was covered by a predominantly oak forest interrupted by tall grass prairie and marsh. The area west of Medicine Lake was covered by a dense deciduous climax forest known as the "Big Woods". Elm, sugar maple and basswood are representative tree species. Scattered remnants of this forest are still present throughout much of its original range.

Natural vegetation in the Bassett Creek watershed has been greatly altered by agricultural development and increasing urbanization. Remaining vegetation in the watershed is typical of the Eastern Deciduous Forest-Temperate Grassland interface. With farming rapidly diminishing in the watershed, urbanization is occurring in former agricultural areas and pressure to develop existing natural areas is occurring. In addition to the forested areas, numerous wetlands were once present in the central and eastern portions of the watershed, but the majority have been drained or filled for development. The remaining wetland areas are concentrated in the western part of the watershed and some are the remnants of approximately 1,500 acres of marsh which once existed between Medicine Lake and Cedar Lake.

For purposes of this report, the study area has been separated into six vegetative categories: flood plain forest, upland hardwood forest, marsh, open water, residential, and industrial-commercial. Data was gathered from field inspections by an upland biologist, interviews with Bureau of Sports Fisheries and Wildlife biologists, and an examination of existing literature. A brief discussion of these categories is presented in the following paragraphs.

Flood Plain Forest

This type of vegetation is very common throughout the watershed forming a narrow strip along much of the creek as well as predominating many of the low-lying undeveloped areas. Various stages of ecological succession are evident in this category as a result of periods of occasional flooding as well as clearing practices which have occurred due to the constant pressures of urban development. Vegetation patterns in this category are highly variable, ranging from light-tolerant saplings, shrubs, and forbs in the areas of most recent revegetation to a near climax community of dominating light-tolerant trees with a shade-tolerant understory of grasses, shrubs, and forbs. Because the watershed is in the process of urbanization, many small and scattered stands of this cover type are present. The major tree species include elm, cottonwood, boxelder, basswood, maple, willow, aspen, ash as well as occasional birch, ironwood and hickory. The understory is chiefly dogwood, buckthorn, honeysuckle, frost grape, burdock, along with other shrub and herbaceous species.

Mammals associated with this type of vegetation include white-tailed deer, skunk, squirrels and mice. Species composition and abundance may vary within the different successional stages exhibited in this category. Migrating waterfowl and shore birds use adjacent marsh area for resting places and some wood duck nesting does occur. Many species of song birds also use this type for breeding and nesting activities. Chickadees, nuthatches and woodpeckers can be found as year-round residents.

Upland Hardwood Forest

This vegetative category can be found in small scattered stands throughout the watershed. However, due to the pressure of agricultural development followed by urban development, this type has been removed from the majority of its original range. Historically, it was known as the "Big Woods" and covered western Hennepin County including the western portions of the watershed. This type also occurred in scattered stands in the eastern portions of the watershed. Plant succession stages within

this type are not as varied as in the flood plain forest. Saplings and shrubs are often poorly developed due to the lack of sunlight penetration. Many of the herbaceous species flourish in the first few weeks of spring before the overstory trees leaf-out. Areas where this vegetative category can still be found are in Theodore Wirth Park and in scattered tracts in the northwestern portion of the watershed where a mixed agricultural-residential land use have, for the time being, allowed these stands to remain. Dominant tree species include oaks (primarily bur and red), elm, basswood, maple, with interspersed ash, horn beam, aspen, birch, wild cherry, hickory, butternut and black walnut.

Mammals common to this category include squirrels, raccoon, white-tailed deer, and mice. Because of the limitation in the size of these wooded areas and their proximity to urban development, species abundance is quite varied in this type. Various migratory as well as permanent resident bird species used this category for nesting and feeding activities. Representative types include woodpeckers, thrushes and sparrows.

Marsh

The low-lying areas are near the edges of lakes, along the margins of the creek itself or are scattered remnants of low-lying areas which have been filled or drained to accommodate agriculture or urbanization. Marsh areas are subject to frequent flooding due to their low elevations, especially during spring snowmelt and following intense summer rain storms.

More than eighty percent of original marshland has been either drained or filled to accommodate agriculture or urbanization. The remaining areas provide valuable open space in this rapidly urbanizing area. Biologically, these sites are highly productive, sustaining both plant and animal organisms that are of basic importance in the food chains of higher animals. These areas are necessary for the existence of many of the existing wildlife species. Waterfowl are especially dependent on these areas for food, cover, resting, and in some cases, nesting. Other species

found in these marsh areas include muskrat, skunk, rabbit, mice, various species of birds and in some areas, white-tailed deer.

According to U.S. Department of Interior Circular No. 39, Wetlands of the United States, the marsh in the watershed is classified either as Type 2 Inland Fresh Meadows or as Type 5 Inland Open Fresh Water.

Type 2 - Inland Fresh Meadow. This type is generally represented by wet, grassy meadows. The soil is usually without standing water during much of the growing season, but is waterlogged within at least a few inches of its surface. Vegetation includes grasses, sedges, rushes, and various broad-leafed plants. Dominant grasses are usually reed canary grass, blue grass, and cord grass. Fresh meadows are used as nesting areas by waterfowl (primarily blue-winged teal), but their main value is supplemental feeding areas. Other species using this type include red-wing blackbirds, pheasants, sparrows and a variety of small mammals.

Type 5 - Inland Open Fresh Water. The water is usually less than 10 feet deep and is fringed by a border of cattails, bulrush, and bur reed. Except for the basin margins, emergent vegetation is nearly lacking. Submergents can be profuse and are usually dominated by pond weed, naiad, wild celery, coontail, water milfoil, and musk grass. Floating vegetation is usually duck weed, water lilies and some species of pond weed. Also included are numerous species of algae with the green, blue-green and diatoms being the representative groups. These areas are used extensively as brood areas during mid or late summer when the less permanent marshes dry up. The borders of such areas are used for nesting and where vegetation is plentiful, are used for feeding and resting by waterfowl, especially during migration periods.

Open Water

This type includes the lakes, permanent ponds, and Bassett Creek itself. The watershed contains approximately 1,800 acres of open water,

of which 1,200 acres have important recreation use. Table 5 lists the major lakes and ponds in the watershed.

TABLE 5

MAJOR LAKES AND PONDS IN THE BASSETT CREEK WATERSHED

Lakes	Area (acres)
Medicine	915
Parkers	88
Sweeney	62
Wirth	38
Twin	27
Westwood	15
Northwood	8
Lost	7
Turtle	3
Ponds	
Dayton	15
Sunset Hill	7
Birch	5

Rooted vegetation is abundant in some of the shallower lakes and ponds with some emergent and floating forms found in all the lakes. With the continuing advance of urbanization, many of these waters are receiving additional nutrients from runoff from surrounding development, causing undesirable algal blooms during the summer months.

Waterfowl make use of this vegetative type, especially as a resting place during waterfowl migration while other bird and wildlife species find food and water at these locations. Fish are common to this type. Blue-winged teal, mallard and wood duck are all known to nest in the watershed using some of these areas for brooding. Numerous song birds, small mammals and an occasional white-tailed deer are transient visitors to these watering areas.

Many invertebrate organisms are abundant in the open water category. The many backwater sloughs around the lakes and along the creek as well as both permanent and temporary marsh areas support populations of limnetic and benthic organisms. These organisms are essential links in the food chains of fish, waterfowl, terrestrial birds and mammals.

Residential

Residential areas occupy the majority of the land area in the watershed. Originally, these areas were wooded or marsh lands which have been cleared or filled to facilitate construction of homes. Portions of this category are located within the flood plain and subject to flood damages.

Residential development ranges from almost total in Minneapolis to about 25 percent in Plymouth. The seven other municipalities are approaching total development, with the present development trend moving from east to west. Most of the municipalities in the watershed have or are formulating comprehensive development plans.

Remnants of forest cover as well as landscaped plants provide shade and shelter for many homes and add to the aesthetic quality of the watershed. Common species in the landscaped plants include a variety of maples, weeping willow, flowering plums, linden and numerous flowering shrubs and herbaceous material. Residents located along the creek have made it known that they wish to keep areas surrounding the creek in their natural state wherever possible. Many yards adjacent to Bassett Creek resemble prime parkland. Included in this category are the numerous recreation areas located throughout the watershed, which provide habitat for birds and small mammals.

Although wildlife habitat is limited in this vegetative type, squirrels, rabbits and a varity of song birds are common. Trees and shrubs are used extensively for feeding and nesting purposes. Deer wander into backyards

along the more heavily wooded reaches of the creek and through sparsely developed areas of the watershed. Waterfowl as well as other bird species use feeders and bird houses provided by residents.

Industrial and Commercial

This vegetative type is found primarily along the major highways and railways in the watershed. Industrial-commercial development along the creek is heaviest in Golden Valley along the reach from T.H. 55 to Winnetka Avenue and in Minneapolis from Glenwood Avenue to the outlet of the creek. Mature woody vegetation is generally lacking in this category with primary tree species being young aspen, boxelder and willow. Most herbaceous vegetation has been removed to facilitate development, however, annual forbs and grasses frequently reestablish themselves on bare ground in these development areas.

Bird and mammal residents are scarce in this type as a result of habitat destruction. However, species such as starling, house sparrow and pidgeon are usually commonplace. The Norwegian rat and house mouse are often undesirable inhabitants of this category. Transient wildlife visitors to these areas include rabbits, squirrels, song birds and even white-tailed deer.

FISH AND WILDLIFE

Fish and wildlife species in the Bassett Creek watershed area maintain a high degree of diversity considering the on-going urbanization of the area. In all, 282 species of birds, 96 species of fish, 57 species of mammals and 33 species of amphibians and reptiles occur in the seven-county metropolitan area. It is expected that most of these species can be found in the Bassett Creek Watershed as evidenced by the diversity of habitat available. Species represented are characteristic of types found throughout the Upper Mississippi River valley in Minnesota. Some of the more representative species are as follows:

Mammals: White-tailed deer, muskrat, raccoon, skunk, fox, ground squirrel, rabbits, and mice.

Birds: Mallard, blue-winged teal, wood duck, coot, bittern, red-tailed hawk and many species of song birds.

Fish: Blue-gill, black crappie, bullhead, northern pike and various species of sunfish and minnows.

Amphibians and Reptiles: Snapping turtle, map turtle, northern water snake, eastern garter snake, northern leopard frog, and the american toad.

Up until the 1860's, man's effect on the environment caused little or no modification in his natural surroundings except in scattered instances. After 1860, man's imprint turned from use to physical modification and development. Obviously, today's fish and wildlife resources have little resemblance to the situation which existed 100 years ago. Agricultural activity linked with urban-industrial development eliminated most of the watershed's original wildlife habitat. With total urbanization of the watershed expected to occur by 1990, the existing undeveloped areas will be subject to increasing development pressure. Some species which have been eliminated from the watershed in the past include bear, cougar, timber wolf and elk as well as such wild fowl as prairie chicken, turkey and sharp-tail grouse.

In the past, the extensive filling and draining of wetlands throughout the watershed has seriously reduced waterfowl populations. At present, over eighty percent of the original wetlands in the watershed have disappeared. Although agriculture is decreasing in the area, urban and industrial development continue to pressure the remaining wetlands.

Recent studies by federal and state agencies indicate that over 30,000 ducks are annually produced in the metropolitan area with mallard, blue-winged teal and wood duck being the most common nesting species. An

expanding Canada goose population annually produces about 500 goslings in the area. A flock of 60 geese is maintained on a large commercial property in Golden Valley as well as by many individuals in the area who maintain a few geese on backyard ponds.

Migratory birds from the Mississippi Flyway begin moving into and through the metropolitan area each spring and fall. The confluence of three major rivers in this portion of the Mississippi Flyway attracts thousands of ducks and geese to the area's marshes and lakes. The extensive marshlands of the river bottoms are especially noted for their large populations of migrating and resident waterfowl which use them for feeding, nesting, breeding, staging and as wintering grounds. Mallards, bluewinged teal and wood ducks being the most common nesting species.

Nearly 14,000 ducks have been known to winter over on open ponds and streams in the metropolitan area. Several hundred have been observed using open water areas along Bassett Creek. Due to tht existing urbanization, hunting is prohibited within the watershed, however, rural areas within easy commuting distance of the watershed provide many acres of potential hunting.

Upland game birds present in the watershed include pheasants, ruffed grouse and some Hungarian partridge. The ruffed grouse population is limited within the watershed due to habitat requirements. With favorable climatic conditions, pheasants are numerous in the western semi-agricultural part of the watershed. Pheasants were introduced in Minnesota in 1905 and annual fall populations have ranged from about 2,500,000 in good years to about 500,000 in poor years. State game records of August road counts made in Hennepin County between 1950 and 1974 demonstrate wide fluctuations in the pheasant population. Variables such as climate, food and cover can account for wide fluctuation in the counts. Other small game species present include gray squirrels, cottontail rabbit and white-tailed jackrabbit.

According to the Minnesota Department of Natural Resources (DNR), commercial trapping is conducted on an individual basis in some parts of

Hennepin County. Although no trapping statistics are available for the Bassett Creek watershed, it is assumed by the DNR, that individuals are operating on a small scale in the less inhabited parts of the watershed. Species taken include: muskrat, red fox and some mink.

The white-tailed deer is the only big game species remaining in Hennepin County and the watershed. About 1,000 deer kills are reported annually in the seven-county metropolitan area, many of these being automobile victims. The deer population in the metropolitan area is estimated by the DNR to be about 8,000 with the major river valleys being perferred habitat areas.

Important non-game bird species in the watershed include the starling, pidgeon, house sparrow and crow. These species appear to be on the increase, competing for food and nesting sites with other more desirable species such as robins, bluebirds and woodpeckers.

Shore birds, gulls and terns are common inhabitants to water environments, especially during spring and fall migrations. Several species of hawks and owls nest in the area. Falcons, osprey and eagles pass through the area during migration. Many species of shore birds and song birds use the area from breeding and nesting as well as feeding and resting stops during migration.

Bassett Creek watershed contains ample resources for recreational and sport fishing. Fish populations vary from lake to lake due to the diversity and quality of habitat provided. Four of the five major lakes in the watershed provide bass and panfish and some northern pike angling. The Minnesota Department of Natural Resources has conducted lake surveys on Sweeney Lake and Medicine Lake in the watershed. It was noted that spawning conditions in both lakes were good for bass and panfish, fair to good for northern pike and poor for walleye. Medicine Lake has two major spawning areas. A large spawning area is maintained on the northern end of Medicine Lake for largemouthed bass and another area is maintained on the west side for northern pike. Past angling records

indicate the lake has always had good fishing, especially for bass. The last creel census for Medicine Lake was taken in 1942. Sweeney Lake has no established spawning areas and angling reports indicate very little fishing pressure. Local reports indicate that fishing is done primarily by children. A possible reason for this is lack of public access to Sweeney Lake. Bassett Creek contains carp, bullheads, sunfish and a variety of minnows. Bassett Creek along with the smaller lakes and ponds provides fishing for many youngsters in the area.

Turtles, frogs, toads and other species of reptiles and amphibians are frequently found in sloughs, marshes, side channels of the lakes and in Bassett Creek itself. Some of the more common species include leopard frog, *common toad*, *painted turtle*, spotted salamander and garter snake.

The variety of aquatic and terrestial invertebrates in the watershed would number into the thousands of species. Groups such as insects, earthworms, clams and snails are invertebrates. Invertebrates play a key role in the food chains of higher animals and are a necessity for man's existence as it is known today. Aquatic invertebrates are very sensitive to changes in water quality and may, therefore, be used as pollution indicators. High populations of bloodworms (chiromonids) are indicators of water with low dissolved oxygen levels. Mayfly, caddisfly, midge and mosquito larvae are important as fish food. There are 47 different species of mosquitos known to exist in the metropolitan area, of which 26 species are know to bite man. Aedes vexan is probably the greatest nuisance species in the metropolitan area.

HISTORICAL AND ARCHAEOLOGICAL RESULTS

Coordination with state and county historical societies and a review of both the National and State Registers of Historic Sites reveals several sites of architectural, archaeological, or historic significance in the general vicinity of the watershed. None of the identified sites would be affected by the project. A surface archaeological reconnaissance of the project area did not identify any sites of historical or archaeological significance,

however, the reconnaissance did identify areas of high and low archaeological potential in the project area. Those areas identified by the reconnaissance will be subject to intensive archaeological investigation during future project studies. Table 6 contains a list of known sites in the vicinity of the watershed.

TABLE 6

HISTORICAL, ARCHITECTURAL, AND ARCHAEOLOGICAL SITES IN THE VICINITY OF THE BASSETT CREEK WATERSHED

Site	Location	Importance
*Cathedral of St. Marks	Minneapolis	Historical & Architectural
Chicago Milwaukee Depot	St. Louis Park	Historical & Architectural
*Mounds	Lot #2, Sec. 26 T. 118N., R22W	Archaeological
Mounds	N 1/2, NW 1/4, Sec. 17, T. 117N, R22W	Archaeological
Mounds	Sec. 8, T. 117N, R22W	Archaeological
St. Anthony Falls	Minneapolis	Historical

*within watershed boundary

Source: Minnesota Historical Society

RECREATION

An abundance of water- and land-based recreational facilities are located around the Minneapolis-St. Paul metropolitan area. Easily accessible from the watershed are one Federally-owned and four State-owned recreation areas. The Federal recreation area is the Lower St. Croix National Scenic Riverway, which includes the reach of the St. Croix River from Taylors Falls, Minnesota to Prescott, Wisconsin. A National Wildlife

Refuge has been proposed along the southern edge of Hennepin County incorporating large areas of Minnesota River bottomland. The State recreation areas include William O'Brien State Park, Fort Snelling State Park, Afton State Park, and the Minnesota River Valley Trail system. The latter two State-owned areas are still in the process of land acquisition and development. Table 7 summarizes existing facilities available at these State-owned recreation areas.

The Hennepin County Park Reserve District has been in existence for almost 20 years and has established several park reserves in the metropolitan area. A park reserve has a minimum size of 1,000 acres and are generally more than 2,000 acres. Eighty percent of the total area of each reserve will be retained in or restored to a natural state--with not more than 20 percent of the area being developed for active recreational use. Because nearly half of Minnesota's population live in the Minneapolis-St. Paul metropolitan area, tracts of natural land large enough to maintain an ecological balance of plant and animal life for present and future generations to enjoy are becoming increasingly rare as well as increasingly essential as urban growth continues throughout Hennepin County. With six park reserves, the District now owns most of the property necessary to serve the projected needs of the county's present and future populations. The existing facilities at these county-owned park reserve are summarized in Table 6. Hennepin County parks which are less than 1,000 acres are classified as regional parks and one has been proposed for the northwest end of Medicine Lake. The proposed Regional Park has been incorporated into the Metropolitan Council's Recreation Open-Space Plan.

The watershed contains many land-based and water-based recreation facilities within its own boundaries. The Metropolitan Council has classified recreation open space in relation to its size and the area serviced by the facility. The mini-park and the neighborhood park-playgrounds are designed to serve small segments of the community population consisting of one or two neighborhoods. The community play field and

TABLE 7

EXISTING REGIONAL RECREATION FACILITIES

Facility	Acres	Fishing	Swimming	Boating	Canoeing	Sailing	Water Skiing	Hiking	Picnicking	Camping	Horseback Riding	Bicycling	Ski Touring	Downhill Skiing	Snow Shoeing	Snowmobiling	Interpretive
State-Owned																	
William O'Brien State Park	1341	X	X		X			X	X	X							
Afton State Park	1648																
Fort Snelling State Park	2500	X	X	X	X			X	X		X		X			X	
Mn. River-Valley Trail System	A																
County-Owned																	
Hyland-Anderson Park Reserve	1596							X	X		X	X	X	X			X
Carver Park Reserve	3794							X	X	X			X				X
Lake Rebecca Park Reserve	2169	X	X	X		X		X	X				X		X		
Morris T. Baker Park Reserve	2712	X	X	X	X	X	X	X	X	X	X		X				
Elm Creek Park Reserve	5000		X						X				X				X
Crow Hassan Park Reserve	2609				X												

A - Land acquisition still in progress.

Source: Development Guide/Policy Plan for Recreation Open Space, Metropolitan Council, 1974.

TABLE 8

METROPOLITAN RECREATION OPEN SPACE SYSTEM

COMPONENT		SERVICE AREA	SITE	SITE ATTRIBUTES	SITE LOCATION
MINI-PARK	Specialized facilities that serve a concentrated or limited population or specific group such as tots or senior citizens; may be in locations such as apartment complexes, townhouse developments or commercial centers.	Less than 1/4 mile	Less than 1 acre		
NEIGHBORHOOD PARK PLAY-GROUND	Are for intense recreational activities such as: field games, court games, crafts, apparatus area, skating, neighborhood centers.	1/4 to 1/2 mile radius to serve a population of 4,000 to 5,000 (neighborhood)	10-25 acres	Physiography suited for intense development	Proximity to elementary schools
COMMUNITY PLAYFIELD	Area for intense recreational facilities such as: athletic fields and swimming pools. Could include neighborhood use.	3-5 neighborhoods (community)	25-50 acres	Physiography suited for intense development	Proximity to secondary schools and other public facilities
COMMUNITY PARK	Area of natural or ornamental quality for outdoor recreation such as: walking, viewing, sitting, picnicking; could have some field and court games.	3-5 neighborhoods (community)	25-100 acres	Affords natural features with varied physiographic interest	Proximity to community facilities & where resources are available

TABLE 8 (cont.)

COMPONENT		SERVICE AREA	SITE	SITE ATTRIBUTES	SITE LOCATION
REGIONAL PARK	Area of natural or ornametal quality for nature oriented outdoor recreation *such as:* picnicking, boating, fishing, swimming, skiing, hiking & camping	3-5 communities	200-550 acres (100 acre minimum)	Complete natural setting contiguous to water bodies or water courses where possible	Where natural resource occurs-particularly water
REGIONAL PARK RESERVE	Area of natural quality for nature oriented outdoor recreation such as: viewing and studying nature, wildlife habitat, conservation, camping, picnicking, hiking & fishing	County Multi-county	1000+ acres; sufficient area to encompass the resource envisioned for preservation	Diversity of unique resources, i.e., topography, lakes, streams, marshes, flora, fauna	Where resource occurs
LINEAR PARK (Trails, parkways)	Area developed for one or more varying modes of recreational travel such as: hiking, biking, snowmobiling, horseback riding, crosscountry skiing, canoeing & driving		Sufficient width to provide maximum protection of resource & maximum use Sufficient length to accomplish purpose	Utilize man-made &/or natural linear resources such as: utility corridors, rights-of-ways, drainagways, bluff lines, vegetation pattern and roads	Where linear resource occurs Link components of recreation system Link other community facilitates such as such as schools, library, and commercial areas
SPECIAL USE	Area providing specialized or single purpose recreational activities such as: golf courses, nature centers, marinas, zoos, conservatories, abtoretum, arenas, gun clubs		Specific standard applicable to desired use	Appropriate to particular special use	Site where needed and appropriate

community park offer facilities to a large segment of the municipality's population, providing recreational activities for several neighborhood areas. Regional and special use areas include linear trails and parkways and serve municipality-wide needs as well as county and state needs. Table 8 gives a more detailed description of the Metropolitan Council's recreation open space categories. The existing recreation resources in the nine municipalities with part or all of their land area within the watershed are discussed in the following paragraphs.

The eastern portion of the watershed including the municipalities of Minneapolis, Crystal, Robbinsdale, New Hope, St. Louis Park, and Golden Valley meet existing recreational needs with neighborhood parks and playgrounds located throughout these communities. In this portion of the watershed, active recreational facilities are dominant, especially in Crystal and Robbinsdale. Rapid urbanization has interfered with the planned development of passive recreation open space as well as trail or walkway systems. This problem is most severe in areas with relatively dense development as well as those where low income neighborhoods are dominant, such as the Glenwood, Harrison, Near North and Willard-Homeward neighborhoods in Minneapolis. In these more densely developed portions of the watershed, trails and natural areas for studying and enjoying the natural environment are few.

The municipalities of Minneapolis, St. Louis Park and Golden Valley have existing or are developing passive recreational areas or nature centers. Theodore Wirth Park along with the Eloise Butler Wildflower Garden provide Minneapolis and Golden Valley residents with passive recreation opportunities. Golden Valley is developing natural areas along Bassett Creek in the area of Rice Lake and along the main stem of Bassett Creek north of Minnaqua Avenue and north of Duluth Street. The area north of Minnaqua Avenue has been desigated by the City of Golden Valley as the Briarwood Bird Sanctuary. St. Louis Park is developing a nature center in the Westwood Lake area. Robbinsdale is currently acquiring land in the area of the north end of Rice Lake to form a natural area in conjunction with Golden Valley on the south end. The existing or proposed trail systems

serve as interconnecting links between recreation facilities, commercial areas and schools within these communities.

Trail systems within the municipalities in the eastern and central part of the watershed range from on-street routes to off-street limestone or asphalt paths. Robbinsdale and Crystal are developing an on-grade system along low traffic residential streets using direction and traffic control signs as needed to delineate and preserve the trails. Golden Valley and New Hope have a combination of on-grade and off-grade systems. The main connecting routes are on-grade with scenic links through parks and along Bassett Creek. Minneapolis provides an off-grade trail through Theodore Wirth Park as part of its continuous trail system which will circle much of the city. Intercommunity trail linkage, as well as connection with the Minnesota Department of Natural Resources' Luce Line Trail in Plymouth, is being discussed by several communities in the watershed.

Plymouth and Minnetonka occupy the western portion of the watershed and are not as urbanized as the communities in the eastern part of the watershed. Planned development of recreational facilities is in the land acquisition phase in Plymouth and Minnetonka. Existing recreational needs are being met and continued planning will anticipate and provide for future recreational needs. Both active and passible recreational facilities are being planned as well as a system of hiking and biking trails.

Special use areas such as golf courses and lakes provide year-round activities. The Brookview Community Golf Course, the Hollydale Golf Course and the Theodore Wirth Golf Course, along with Felders Golf Center, are public use facilities. The Golden Valley Country Club golf course in Golden Valley and the Minneapolis Golf Club golf course in St. Louis Park are private facilities. As well as providing golf in the summer months, the public courses serve a multiple-use function by providing cross-country skiing during the winter months.

Portions of three golf courses are in the existing 100-year flood plain of Bassett Creek. These courses are the Theodore Wirth, the Golden Valley Country Club, and the Brookview Community golf courses. Large areas of these courses are inundated during a 100-year flood, restricting their use for several days following a flood. With existing conditions,

the water level in Theodore Wirth Park can be expected to be above the normal level for approximately 24 days after a 100-year event and for approximately 7 days following a 10-year flood event. It is anticipated the course will be playable when the water level returns to about 1 foot above normal, which would be about 7 days for a 100-year frequency flood and 4 days for a 10-year frequency flood. User rates for Theodore Wirth course indicate approximately 200 recreation days would be lost per day the course is closed. The Golden Valley Golf Club would lose approximately 160 recreation days per day if closed, and the Brookview Community Golf Course would lose an average of 280 recreation days per day if the course were closed.

Wirth Lake, Sweeney Lake, Twin Lake, Parkers Lake and Medicine Lake offer opportunities for fishing, boating, sailboating, canoeing and swimming. Wirth Lake serves the Minneapolis neighborhoods on the northside who have limited access to other lakes because of transportation limitations. Sweeney Lake and Twin Lake offer limited recreational opportunity to the watershed because there is no public access to these lakes. Parkers Lake has a public access for non-motorized craft only. Although Medicine Lake has no public access, the Minnesota Department of Natural Resources is negotiating with the City of Plymouth to obtain the necessary land for a public access. The recreational opportunities of these lakes is summarized in Table 9. The recreation resources of the municipalities within the Bassett Creek Watershed are summarized in Table 10.

PUBLIC HEALTH AND SAFETY

The health and safety of residents in the study area are potentially affected during major flood periods. No flood-related deaths are known to have occurred, but a serious threat to life is always present during flood periods due to flooded residences and the related potential for electrical shocks and injurous falls, and due to attempted movement along flooded thoroughfares. Other previously experienced and future threats to public health and safety include impediment of local traffic, vermin from flooded areas, contamination of private water supplies, damage to wastewater collection facilities, and increased disease vector production during a major flood.

Isolation of areas by flood waters could also create hazards in terms of supplying emergency medical, fire or law enforcement services. The potential for a fuel spill in the vicinity of the conduit inlet is always present during major floods due to the possible dislocation or damage to fuel storage tanks located in that area.

TABLE 9

RECREATIONAL OPPORTUNITIES AT LAKES WITHIN THE WATERSHED

Lake/Activity	FISHING	BOATING	SAILBOATING	CANOEING	SWIMMING
Wirth Lake	X			X	X
Sweeney Lake*	X			X	
Twin Lake*	X			X	
Medicine Lake*	X	X	X	X	X
Parkers Lake	X		X	X	

*Limited by lack of public access for boating

TABLE 10

SUMMARY OF RECREATION RESOURCES IN BASSETT CREEK WATERSHED

METROPOLITAN COUNCIL CATEGORY

Community	Area in Watershed (acres)	Miles of Creek Within Community	Mini-Parks	Neighborhood Playground	Community Playfield	Community Park	Linear Park (trail mile)	Golf Course	Special Use Lake	Special Use Nature Center	Special Use Swimming Beaches
Plymouth[1,3]	11,122	6.7[2]	0*	39*	0*	5*	60*	1	3	0	2
Minnetonka[1,3]	1,082	0	2	1	0	0	1	0	1	1*	0
St. Louis Park[3]	854	0	1	0	0	1	3	1	1	1	0
Golden Valley[3]	6,432	8.7	1	11	5	1	31	2	3	1*	0
Minneapolis[3]	2,200	3	4	1	1	1	5	1	0	0	1
Crystal[3]	1,325	1.7	0	3	3	1	6	0	0	0	0
Robbinsdale[3]	367	0	1	1	0	0	2	0	1	1*	0
New Hope[3]	1,105	1.1	2	2	1	1	2	0	0	1	0
Medicine Lake[3]	128	0	0	0	0	1	0	0	1	0	2

*Proposed

[1]Comprehensive recreation plan, not complete data, recorded in proposal form

[2]Includes Plymouth Creek

[3]Portion of municipality within the watershed only

HUMAN RESOURCES

The Bassett Creek watershed lies entirely within Hennepin County; one of seven counties within the Minneapolis-St. Paul metropolitan area. The Metropolitan Council independently complies census data and forecasts population, employment and number of households for each municipality within the seven-county metropolitan area. Hennepin County is within the Minneapolis-St. Paul Standard Metropolitan Statistical Area (SMSA) which includes five of the seven counties within the Minneapolis-St. Paul metropolitan area. The 1972 OBERS Series E Projections provide population, employment and income projections for the Minneapolis-St. Paul SMSA.

POPULATION CHARACTERISTICS

The 1970 estimated population for the Bassett Creek watershed was 87,400. Population density varies widely throughout the watershed, but averages 3.2 people per acre. Plate B-4 shows how the 1970 population density varies throughout the watershed. Average 1970 population density in the Minneapolis-St. Paul SMSA was 1.3 people per acre. This indicates that the Bassett Creek watershed is significantly more urbanized than the Minneapolis-St. Paul SMSA. The portion of the watershed in Minneapolis is the most densely populated, averaging 9.6 people per acre, while Plymouth is the most sparsely populated, averaging less than one person per acre. Table 11 indicates the average population density for each municipality within the watershed.

The age distribution of the 1970 population is shown in Table 11. These age characteristics apply to the entire community, but are typical of that portion of each municipality which lies within the watershed. These statistics indicate that about 50% of the watershed population is in the productive age group of age 19 to 64. In the cities of Crystal, Golden Valley, Minnetonka, New Hope and Plymouth, more than 50% of the population is under age 25 and more than 40% of the population is under age 18.

TABLE 11

1970 POPULATION CHARACTERISTICS

Area	Population[1]	Population Density[1] population/acre	Population by Age[2] 0-5	6-18	19-24	25-35	36-64	65-older
			percent					
Crystal	10,700	8.1	12.3	31.5	8.7	15.1	29.1	3.3
Golden Valley	24,200	3.6	10.5	31.6	7.0	11.8	34.5	4.6
Medicine Lake	446	4.0	13.5	24.9	8.6	15.8	32.2	5.0
Minneapolis	26,400	9.6	8.9	19.9	14.9	12.4	28.9	15.0
Minnetonka	1,720	1.4	11.5	33.6	5.2	13.1	31.9	4.7
New Hope	7,890	6.4	15.6	30.3	10.2	19.1	21.6	3.2
Plymouth	8,380	.8	12.9	30.9	7.7	16.9	28.1	3.5
Robbinsdale	3,200	7.6	8.8	25.5	9.1	11.0	35.5	10.1
St. Louis Park	4,430	4.6	10.0	24.2	9.6	14.6	33.0	8.6
Bassett Creek Watershed	87,400	3.2	10.9	27.3	9.8	13.8	30.4	7.8
Hennepin County	960,080	2.5	10.4	25.2	11.5	13.6	29.6	9.7
Mpls.-St. Paul SMSA	1,813,647	1.3	9.3	28.8	10.7	13.9	28.5	8.8

[1]That portion of the municipality in Bassett Creek Watershed.

[2]For the entire municipality.

Source: U.S. Census of Population and Housing, 1970.

Projected population data for the Bassett Creek watershed has been adopted from the preliminary projections made by the Metropolitan Council in October, 1974. Metropolitan Council population projections were used because these projections are made for each municipality in the seven county metropolitan area and take into account the potential growth characteristics of each municipality. In addition, the use of the Metropolitan Council projections for the watershed is justified since they are not significantly different from the OBERS projections for the Minneapolis-St. Paul SMSA as is shown in Table 12.

Between 1960 and 1970, the population in the watershed increased 28.2% as is shown in Table 13. Between 1960 and 1970, Robbinsdale and Minnetonka experienced slight to moderate growth rates of 6.1% and 1.9%, respectively. The portion of the watershed which lies within Minneapolis was the only area where the population decreased during this time period. The greatest population increases occurred in the municipalities in the western portion of the watershed. The municipalities of Crystal, Golden Valley, Medicine Lake, Plymouth and St. Louis Park had population increases in excess of 24%. The portion of the watershed which lies within New Hope experienced the greatest population increase, approximately 500%.

The watershed's population was estimated to be 92,600 in 1974 and represents an increase of 5.9% since 1970. Between 1970 and 1974, Plymouth experienced the largest population increase (43.2%) and Minneapolis experienced the greatest decrease in population (-2.3%).

The historic and projected population data for the watershed is summarized in Table 13. The historical population data has been taken from the 1950, 1960 and 1970 census reports of the Department of Commerce's Bureau of the Census. As shown in Table 13, the population of the Bassett Creek watershed is projected to increase at a declining rate through the year 2030. The Metropolitan Council's projections have been used for the watershed populations since they agree closely with the OBERS projections for the Minneapolis-St. Paul SMSA. The estimated population for the watershed by the year 2030 is 122,000 and represents a 40% increase from

TABLE 12

COMPARISON OF POPULATION
PROJECTIONS FOR THE
MINNEAPOLIS-ST. PAUL SMSA

	1980	1990	2000
Metropolitan Council	2,112,600	2,442,650	2,734,600
Difference from OBERS	0.8%	-.6%	-.9%
OBERS	2,095,000	2,455,600	2,760,000

Source: Population Forecasts (Preliminary), Metropolitan Council, October, 1974.

OBERS Projections, Office of Business Economics, Department of Commerce, April, 1974.

TABLE 13

HISTORIC AND PROJECTED POPULATION

	1950	1960	1970	1974	1980	1990	2000	2020	2030
Crystal[1]	2,040	6,230	10,700	10,900	10,700	9,500	9,250	10,700[2]	10,700[2]
% Change		250	71.1	1.9	-1.8	-11.2	-2.6	15.6	0
Golden Valley	5,551	14,559	24,246	25,100	25,800	26,900	27,600	28,800[2]	29,300[2]
% Change		163	66.3	3.5	2.8	3.9	3.0	4.3	1.7
Medicine Lake	284	323	446	446	450	400	400	450[2]	450[2]
% Change		13.7	38.1	4.5	-3.4	-11.1	0	11.1	0
Minneapolis[1]	37,100	31,600	26,400	25,800	25,600	26,300	26,800	26,000[2]	26,000[2]
% Change		-14.8	-17.1	-2.3	-0.8	2.7	1.9	-3.0	0
Minnetonka[1]	800	1,620	1,720	1,840	1,990	2,390	2,590	2,780[2]	2,820[2]
% Change		102	6.1	6.9	8.1	21.7	8.3	7.3	1.4
New Hope[1]	260	1,230	7,890	8,850	8,880	8,510	8,200	8,800[2]	8,500[2]
% Change		373	498	12.2	0.3	-4.2	-3.8	7.3	-3.4
Plymouth[1]	3,500	5,000	8,380	12,000	17,000	23,400	29,700	36,000[2]	37,000[2]
% Change		42.9	71.0	43.2	41.7	37.6	26.9	21.2	2.8
Robbinsdale[1]	2,480	3,140	3,200	3,150	3,350	2,840	2,780	3,300[2]	3,000[2]
% Change		26.6	1.9	-1.6	6.3	-15.2	-2.1	18.7	-9.1
St. Louis Park[1]	1,100	3,530	4,390	4,490	4,450	4,360	4,310	4,400[2]	4,400[2]
% Change		221	24.3	2.0	-0.7	-2.0	-1.1	2.1	0
Bassett Creek Watershed	53,100	67,200	84,400	92,600	98,200	104,500	112,000	121,000[2]	122,000[2]
% Change		26.6	30.1	5.9	6.4	6.4	7.2	4.6	0.8
Hennepin County	676,579	842,854	960,080	997,011	1,033,750	1,117,500	1,181,800	--	--
% Change		24.6	13.9	3.8	3.7	8.1	5.8		
Mpls.-St. Paul SMSA	1,151,656	1,482,030	1,821,718	1,953,764	2,095,000	2,455,600	2,760,000	3,284,600	3,500,000[2]
% Change		28.1	22.9	7.2	7.2	12.4	12.4		6.6
Seven County Metro Area	1,185,694	1,525,297	1,874,612	2,026,771	2,195,000	--	2,888,000	--	--
% Change		28.6	22.9		17.1		21.6		
Mpls.-St. Paul OBE Economic Area	2,174,822	2,666,187	2,948,462	1,953,764	3,260,700	--	4,048,400	4,640,200	4,880,000[2]
% Change		22.5	10.6		10.6		24.1	14.6	5.2
Minnesota	2,997,000	3,413,864	3,822,000	--	4,119,400	--	4,900,700	5,496,700	5,780,000[2]
% Change		13.9	11.9		7.8		19.0	12.1	5.1
United States	151,236,648	179,323,175	203,857,864	--	223,532,000	--	263,830,000	297,146,000	--
% Change		18.6	13.7		14.6		18.0	12.6	

[1] That portion of the municipality in Bassett Creek watershed.

[2] Extrapolated

Source: U.S. Census of Population and Housing, 1970. Population Forecasts (Preliminary), Metropolitan Council, October, 1974. OBERS Projections. Office of Business Economics, Department of Commerce, April, 1974.

1970. This results in an average density of 4.4 people per acre in the watershed by 2030. The extrapolated OBERS projections indicate a 92% population increase by the year 2030 for the Minneapolis-St. Paul SMSA, resulting in an average density of 3.3 people per acre. The Minneapolis-St. Paul SMSA is projected to experience a greater population increase than the watershed since the SMSA will experience continued urbanization through 2030, whereas the Bassett Creek watershed is expected to be totally urbanized by 1990 based on current development trends.

A large portion of the Bassett Creek watershed, especially Crystal, Medicine Lake, Minneapolis, New Hope, Robbinsdale and St. Louis Park, are considered to be near total urbanization and, therefore, no major changes in population due to migration is expected within these municipalities. The majority of future urbanization in the watershed will occur in Plymouth. That portion of the watershed within Plymouth is expected to increase from 1974 population of 12,000 to approximately 30,000 in 2000 and to approximately 37,000 in 2030. The communities of Golden Valley and Minnetonka are projected to have slow population growth. The projected population for Golden Valley is 29,300 in 2030 and for the portion of the watershed in Minnetonka, the projected population is 2,820 in 2030.

EDUCATION

The 1970 education statistics for the Bassett Creek watershed are shown in Table 14. Within the Bassett Creek watershed, approximately 69% of the population over the age of 24 have graduated from high school. This is considerably above the national average of 53% and the Minnesota average of 58.7%. In the Minneapolis portion of the watershed, less than 50% of the population over the age of 24 are high school graduates, whereas in Crystal, Golden Valley, Minnetonka, New Hope, Plymouth and St. Louis Park more than 75% of the population over the age of 24 are high school graduates.

As shown on Table 14, approximately 17.2% of the population within the Bassett Creek watershed over the age of 24 have four or more years

TABLE 14

1970 EDUCATION STATISTICS

Area	Number of Persons Age 25 and Over	0-8 Years School	At Least High School Graduate	DISTRIBUTION OF HIGH SCHOOL GRADUATES		
				High School Graduate Only	1-3 Years College	4 or More Years College
Crystal[1]	5,150	8.7%	77.4%	44.4%	17.4%	15.6%
Golden Valley[1]	12,300	7.5	82.6	35.1	20.2	27.3
Minneapolis[1]	15,100	30.9	45.8	30.7	9.0	6.1
Minnetonka[1]	880	10.9	80.1	39.3	18.9	21.9
New Hope[1]	3,570	6.5	84.9	41.3	19.0	24.6
Plymouth[1]	4,310	12.9	77.6	38.7	16.3	22.6
Robbinsdale[1]	1,750	15.8	67.5	46.2	11.2	10.1
St. Louis Park[1]	2,220	3.2	80.4	38.6	22.3	19.5
Bassett Creek Watershed	45,300	17.5	68.9	36.3	15.4	17.2
Hennepin County	507,299	17.8	68.0	36.6	15.3	16.1
Mpls.-St. Paul SMSA	928,219	19.1	66.1	37.5	13.8	14.8
Minnesota	1,990,367	28.5	57.6	34.5	12.0	11.1
United States	109,899,359	28.3	52.5	31.1	10.7	10.7

[1]That portion of the municipality in Bassett Creek Watershed

Source: U.S. Census of Population and Housing, 1970.

of college. The municipality with the highest percentage of its population over the age of 24 having four or more years of college is Golden Valley with 27.3%. The municipality with the lowest percentage is Minneapolis with 6.1%.

Within the Bassett Creek watershed, approximately 17.5% of the population over the age of 24 have less than 9 years of formal education. As indicated in Table 14, Minneapolis has the largest percentage of persons over the age of 24 with less than 9 years of formal education while St. Louis Park has the smallest percentage of persons over the age of 24 with less than 9 years of formal education. The 17.5% of the population over the age of 24 in the Bassett Creek watershed with less than 9 years of formal education is approximately the same percentage as that for Hennepin County (17.8%) and a slightly smaller percentage than that for the Minneapolis-St. Paul SMSA (19.1%).

OCCUPATIONS

The 1970 distribution of occupations for the labor force in the Bassett Creek watershed is shown in Table 15. The 1970 census data indicates that clerical or related occupations are the most common occupations of residents in the Bassett Creek watershed. Approximately 19.7% of the labor force in the watershed was employed in the clerical or related fields in 1970. The second most common occupation of residents in the watershed is the professional, technical and related fields which included 18.9% of the labor force in 1970. The remaining occupations in order of their prevalence were: operatives; craftsmen, foreman and kindred workers; service workers; managers and administrators, sales workers; and laborers and farm workers. Approximately 41% of the female labor force was employed as clerical workers in 1970.[1] In contrast, 7% of the male labor force was employed as clerical workers in 1970.[2]

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[1] A Demographic Profile of 33 Communities in Hennepin County, Community Health and Welfare Council, March, 1973. Report is based on 1970 Census data for Hennepin County.

[2] Ibid.

TABLE 15

1970 OCCUPATION STATISTICS

Area	Total Labor Force	Professional Technical & Kindred	Managers & Administrators Except Farm	Sales Workers	Clerical & Kindred	Craftsmen Foreman & Kindred	Operatives	Laborers & Farm Workers	Service Workers	Unemployed
Crystal[1]	4,810	20.3%	9.6%	8.8%	20.5%	14.1%	13.5%	3.0%	9.2%	1.0%
Golden Valley[1]	10,260	23.9	16.8	11.6	19.4	8.3	7.3	2.4	7.5	2.8
Minneapolis[1]	11,000	10.8	3.9	4.0	19.4	12.7	22.2	5.3	16.7	5.0
Minnetonka[1]	740	21.0	14.3	8.2	17.5	12.8	11.3	3.5	8.8	2.6
New Hope[1]	3,320	24.5	14.4	9.3	20.2	10.4	9.2	2.6	7.4	2.0
Plymouth[1]	3,680	23.4	12.9	10.2	17.4	12.6	10.9	2.5	8.6	1.5
Robbinsdale[1]	1,520	14.8	7.6	8.0	26.8	11.4	12.7	4.3	13.0	1.4
St. Louis Park[1]	1,900	19.0	13.0	14.5	19.5	9.2	9.9	3.5	9.2	2.2
Bassett Creek Watershed	37,200	18.9	10.8	8.6	19.7	11.2	13.5	3.5	10.9	2.9
Hennepin County	434,705	17.9	9.5	8.4	21.6	10.9	12.6	3.8	12.2	3.1
Minneapolis-St. Paul SMSA	768,806	17.8%	8.6%	7.5%	20.9%	13.6%	13.6%	4.3%	12.0%	3.2%

[1]That portion of the municipality in Bassett Creek Watershed

Source: U.S. Census of Population and Housing, 1970.

The distribution of occupations throughout the watershed appears to correspond to the education level of the individual municipalities. Communities with higher educational levels tend to have a greater percent of their population employed in occupations that generally require more educational training. For example, Golden Valley, one of the communities with the highest educational levels, has 49% of its labor force employed in the occupational categories of professional and technical; managerial and administrative; craftsmen and foremen. The watershed average for these occupational categories is 40.9%.

In the watershed the distribution of the labor force among the occupational categories is similar to the distribution in Hennepin County and the Minneapolis-St. Paul SMSA. The historic and projected occupation distribution of the Minneapolis-St. Paul SMSA is summarized in Table 16.

EMPLOYMENT

The labor force within the Bassett Creek watershed was approximately 37,200 persons in 1970. The distribution of the labor force between the municipalities in the watershed is shown in Table 17. An estimated, 1,808 people or 2.9% of the labor force in the watershed were unemployed in 1970. In 1970, the Minneapolis portion of the watershed had the largest labor force with 11,000 workers and the largest unemployment rate at 5.0%. Of the municipalities within the watershed, Crystal had the lowest unemployment rate at 1.0% in 1970. Male, female and total 1970 employment rates in the watershed are slightly less than the corresponding rates in the Minneapolis-St. Paul SMSA.

The male labor force within the watershed was approximately 22,800 or 61% of the total labor force in 1970. About 3.2% of the watershed's male labor force were unemployed in 1970. Minneapolis had the highest male unemployment rate at 5.7% in 1970, which was almost twice the male unemployment rate of any other municipality in the watershed. The Crystal and New Hope portions of the watershed had the lowest male unemployment rates at 0.9% in 1970.

TABLE 16

HISTORIC AND PROJECTED EMPLOYMENT BY OCCUPATION
FOR THE MINNEAPOLIS-ST. PAUL SMSA

	1960	1970	Percent Change 1960-1970	1980	Percent Change 1970-1980
Professionals, Technicals and Kindred Workers	79,599	139,442	75.2	208,573	49.6
Managers and Administrators	50,398	62,088	23.2	75,451	21.6
Sales Workers	50,174	56,976	13.6	75,550	32.6
Clerical and Kindred Workers	112,635	159,954	42.0	210,883	31.8
Craftsmen, Foreman and Kindred Workers	77,155	90,527	17.3	109,914	21.4
Operatives	86,832	105,994	22.0	124,434	17.4
Laborers	22,682	23,778	4.8	23,612	-0.7
Farmers and Farm Workers	6,663	3,367	-49.5	2,498	-25.7
Service Workers	62,246	82,714	32.9	116,130	40.4
TOTAL EMPLOYMENT	576,082	759,443	31.8	947,045	24.7

Source: Minnesota Employment Projections 1960-1970, Minnesota Department of Employment Services, March, 1974.

TABLE 17

1970 EMPLOYMENT STATISTICS

Area	Male Labor Force	Male Unemployment Percent	Female Labor Force	Female Unemployment Percent	Total Labor Force	Total Unemployment Percent
Crystal[1]	3,010	0.9	1,800	1.0	4,810	1.0
Golden Valley[1]	6,555	2.9	3,705	2.6	10,260	2.8
Minneapolis[1]	6,220	5.7	4,810	4.0	11,000	5.0
Minnetonka[1]	480	2.1	260	3.5	740	2.6
New Hope[1]	2,110	0.9	1,210	3.8	3,320	2.0
Plymouth[1]	2,360	1.5	1,320	1.5	3,680	1.5
Robbinsdale[1]	890	1.9	630	0.6	1,520	1.4
St. Louis Park[1]	1,210	2.1	690	2.5	1,900	2.2
Bassett Creek Watershed	22,800	3.0	14,400	2.8	37,200	2.9
Hennepin County	253,368	3.1	181,337	3.2	434,705	3.1
Minneapolis-St. Paul SMSA	469,515	3.1	317,291	3.4	786,806	3.2

[1]That portion of the municipality in Bassett Creek Watershed.

Source: U.S. Census of Population and Housing, 1970.

The female labor force in the watershed was approximately 14,400 or 39% of the total labor force in 1970. The female unemployment in the watershed was 2.8% in 1970. The portion of the watershed in Minneapolis, Minnetonka and New Hope have the highest female unemployment rates in 1970 with 4.0%, 3.5% and 3.8%; respectively. Robbinsdale had the lowest female unemployment rate at 0.6% in 1970.

Between 1960 and 1970, total employment increased 30.8% in the Minneapolis-St. Paul SMSA. Mining, services, durable goods manufacturing and wholesale trade were the industries that had the greatest percentage increase in employment between 1960 and 1970 as shown in Table 18. Between 1970 and 1980, the retail trade and the services industries are projected to have the greatest percentage increase in employment. Due to increased urbanization within the Minneapolis-St. Paul SMSA, employment in agriculture declined significantly between 1960 and 1970 and will continue to decline between 1970 and 1980.

Since the unemployment rates and employment by occupation statistics for the Bassett Creek watershed and the Minneapolis-St. Paul SMSA are similar, employment projections for the Minneapolis-St. Paul SMSA provide a reasonable basis for the projected employment within the Bassett Creek watershed.

Employment projections for the Minneapolis-St. Paul SMSA are made independently by the Metropolitan Council, the Minnesota Department of Employment Services, and OBERS. A comparison of these projections is shown in Table 19. Employment projections made by the Minnesota Department of Employment Services as shown in Table 19 indicate that total employment within the Minneapolis-St. Paul SMSA will increase approximately 28% between 1970 and 1980. The service and retail industries are projected to have the greatest percentage increase in employment during this period. The OBERS projection for total employment in the Minneapolis-St. Paul SMSA indicate a 29% increase between 1970 and 1980. Extrapolated OBERS projections indicate a total employment of 1,590,000 for the Minneapolis-St. Paul SMSA in the year 2030. The Metropolitan Council has made total employment

TABLE 18

HISTORIC AND PROJECTED EMPLOYMENT BY INDUSTRY
FOR THE MINNEAPOLIS-ST. PAUL AREA

Industry	1960	1970	Percent Change 1960-1970	1980	Percent Change 1970-1980
Agriculture, Forestry & Fisheries	7,951	5,642	-29.0	4,410	-21.8
Mining	374	630	68.4	676	7.3
Construction	33,645	41,163	22.3	44,358	7.8
Durable Goods Manufacturing	81,614	116,207	42.4	144,505	24.4
Non-Durable Goods Manufacturing	75,696	71,654	-5.3	79,848	11.3
Transportation, Communication, Public Utilities	52,749	56,638	7.4	67,188	18.6
Wholesale Trade	34,291	47,938	39.8	58,798	22.7
Retail Trade	93,722	127,080	35.6	168,955	33.0
Finance, Insurance, Real Estate	36,566	47,555	30.1	59,825	25.8
Services	133,250	213,950	60.6	311,254	45.6
Public Administration	26,264	31,149	18.6	32,657	4.8
TOTAL EMPLOYMENT	576,122	759,606	31.8	972,474	28.0

Source: Minnesota Employment Projections 1960-1980, Minnesota Department of Employment Services, March, 1974.

TABLE 19
COMPARISON OF HISTORIC AND PROJECTED EMPLOYMENT
FOR THE MINNEAPOLIS-ST. PAUL SMSA

	1950	1960	1970	1980	1990	2000	2020	2030[1]
Metropolitan Council	--	--	841,179	1,066,940	1,290,750	1,539,000	--	--
Difference from OBERS	--	--	--	6.7%	10.7%	15.3%	--	--
Minnesota Department of Employment Services	--	576,122	759,606	972,474	--	--	--	--
Difference from OBERS	--	--	-1.9%	-2.5%	--	--	--	--
OBERS	475,029	577,993	772,527	999,800	1,166,000	1,334,800	1,521,900	1,590,000[1]
Percent Change	--	21.7	33.7	29.4	16.6	14.5	14.0	4.5

[1]Extrapolated

Sources: OBERS
Metropolitan Council
MDES

projections for each municipality in the Bassett Creek watershed through the year 2000. The Metropolitan Council's total employment projections are summarized in Table 20.

INCOME

Average annual per capita income in the Bassett Creek watershed was $3,850 in 1970.[3] This is slightly greater than average annual per capita income in Hennepin County and 6% greater than average per capita income in the Minneapolis-St. Paul SMSA. The average annual per capita income in 1970 for the Bassett Creek watershed and for each municipality within the watershed is shown in Table 21. Golden Valley had the highest average annual per capita income of $4,950 in the watershed in 1970.

Table 22 shows the distribution of family income for the Bassett Creek watershed in 1970. Although the population in the watershed was a relatively high average annual per capita income, there is a high percentage of families having incomes below the poverty level. The poverty threshold for the non-farm family of four was $4,743 in 1969. Approximately 6.8% of the families within the watershed had incomes below the poverty level in 1970. This corresponds to 4.6% and 4.5% of the families in Hennepin County and the Minneapolis-St. Paul SMSA, respectively, with income below the poverty level in 1970. Of the 1,506 families in the watershed with income below the poverty level in 1970, 1,176 of the families were living in Minneapolis. Golden Valley and New Hope both with 1.9%, had the smallest percentage of families with income below the poverty level in 1970.

The historic and projected average annual per capita income for the Minneapolis-St. Paul SMSA is presented in Table 23. Per capita income for the Minneapolis-St. Paul SMSA increased 64% between 1950 and 1970. The average annual per capita income for the Minneapolis-St. Paul SMSA is projected to increase to $17,500 and represents an increase of 325% between 1970 and 2030. The average annual per capita income of $17,500 in 2030 was obtained by extrapolating the OBERS projections for the Minneapolis-St. Paul SMSA.

[3]This was calculated using 1969 income and 1970 population.

TABLE 20

EMPLOYMENT FORECASTS

Area	1970	1980	1990	2000
Crystal[1]	5,623	7,200	8,800	9,100
Golden Valley[1]	18,985	22,200	24,500	25,000
Medicine Lake[1]	36	50	60	100
Minneapolis[1]	209,324	305,500	322,000	333,500
Minnetonka[1]	5,736	13,000	22,000	35,000
New Hope[1]	4,415	6,800	9,300	9,700
Plymouth[1]	6,587	12,700	17,400	23,400
Robbinsdale[1]	4,416	6,100	6,500	7,000
St. Louis Park[1]	30,788	37,000	38,000	39,000
Bassett Creek Watershed[2]	366,910	407,550	448,600	481,800
Hennepin County	505,424	611,450	695,660	784,900
Minneapolis-St. Paul SMSA	841,179	1,066,940	1,290,750	1,539,000

[1]Entire municipality

[2]Total employment for all municipalities

Source: Metropolitan Council

TABLE 21

1970 PERSONAL INCOME STATISTICS

Area	Average Annual Per Capita Income[2]
Crystal[1]	3,780
Golden Valley[1]	4,950
Minneapolis[1]	2,900
Minnetonka[1]	4,180
New Hope[1]	3,550
Plymouth[1,3]	4,250
Robbinsdale[1]	3,370
St. Louis Park[1]	4,120
Bassett Creek Watershed	3,850
Hennepin County	3,840
Minneapolis-St. Paul SMSA	3,620

[1]That portion of the municipality in Bassett Creek Watershed

[2]Found by dividing 1969 income by 1970 population. This results in a discrepancy between these figures and the OBERS figures for the Minneapolis-St. Paul SMSA.

[3]Includes Medicine Lake

Source: U.S. Census of Population and Housing, 1970.

TABLE 22

1970 FAMILY INCOME STATISTICS

Area	Number of Families	Less Than $5,000	$5,000 to $6,999	$7,000 to $8,999	$ 9,000 to $11,999	$12,000 to $14,999	$15,000 to $24,999	$25,000 or Over	Families With Income Below Poverty Level Number	Percent
Crystal[1]	2,660	6.9%	3.6%	10.2%	25.4%	21.5%	27.3%	5.1%	68	2.6
Golden Valley[1]	6,020	4.7	3.8	4.3	15.6	14.8	37.7	19.1%	114	1.9
Minneapolis[1]	7,170	29.1	11.6	13.5	18.0	12.9	12.5	2.4	1,176	16.4
Minnetonka[1]	450	5.6	3.3	6.9	23.7	20.1	29.2	11.2	13	2.9
New Hope[1]	1,890	3.8	5.0	8.3	22.2	24.6	31.6	4.5	35	1.9
Plymouth[1]	2,130	6.2	5.3	8.3	19.4	18.6	32.5	9.7	43	2.0
Robbinsdale[1]	840	9.5	8.3	14.0	23.5	19.6	23.6	1.5	27	3.2
St. Louis Park[1]	1,140	6.0	4.5	9.4	24.2	.	23.2	12.8	30	2.6
Bassett Creek Watershed	22,300	13.2	6.7	9.4	19.4	16.7	25.8	8.8	1,506	6.8
Hennepin County	223,910	11.9	7.4	11.0	21.2	18.2	23.1	7.2	10,964	4.6
Minneapolis-St. Paul SMSA	437,121	11.2%	7.3%	11.2%	22.8%	18.9%	22.4%	6.2%	20,004	4.5

[1]That portion of the municipality in Bassett Creek Watershed

Source: U.S. Census of Population and Housing, 1970.

TABLE 23

HISTORIC AND PROJECTED ECONOMIC DATA FOR THE

MINNEAPOLIS-ST. PAUL SMSA

	1950	1960	1970	1980	1990	2000	2020	2030[2]
Population	1,156,656	1,482,030	1,821,718	2,095,000	2,455,600	2,760,000	3,284,600	3,500,000
% Increase		28.1	22.9	15.0	17.2	12.4	19.0	6.6
Per Capita Income (1967 $)	2,517	3,000[1]	4,117	5,600	7,100	9,200	14,400	17,500
% Increase		19.2	37.3	36.1	26.8	29.5	56.5	21.5
Per Capita Income Relative to U.S. (U.S. = 1.00)	1.22	1.20[1]	1.18	1.18	1.16	1.13	1.09	
Total Employment	475,029	577,993	772,527	999,800	1,166,000	1,334,800	1,521,900	1,590,000
% Increase		21.6	33.6	29.4	16.6	14.5	14.0	4.5
Total Personal Income (Thousand of 1967 Dollars)	$2,911,056	$4,443,400	$7,500,144	$11,864,500	$17,541,200	$25,481,800	$47,317,100	$60,000,000

[1]Interpolated

[2]Values for the year 2030 are extrapolated

Source: OBERS Projections, Office of Business Economics, Dept. of Commerce, April, 1974.

DEVELOPMENT AND ECONOMY

PRESENT DEVELOPMENT

The original settlement of the Twin Cities area began in 1820 by the establishment of the Fort St. Anthony Military Reservation, renamed Fort Snelling in 1825. As a mode of transportation and as a central source of power, the Mississippi River provided a base for the industrial development of the area. The flour milling and lumbering industries and their associated supportive activities established the Twin Cities as the regional trade, financial and transportation center of the Upper Midwest. Although lumbering is no longer a viable industry in the metropolitan area, the food processing industries along with printing and publishing, the manufacture of precision instruments, computers, electronic equipment, electrical machinery and transportation machinery are important to the economy of the area. At the present time, no single industry dominates the economy of the Twin Cities metropolitan area.

The Bassett Creek watershed occupies an area of approximately 42 square miles on the western edge of the rapidly expanding Minneapolis-St. Paul metropolitan area. At the present time, approximately 60% of the watershed's total area is in a state of total or partial urbanization. The state of urbanization varies from total in Minneapolis to negligible in the western portions of Plymouth. In those communities which have experienced considerable growth within the last 15 years, the contemporary patterns of land utilization are apparent. Although many of these areas can be considered fully urbanized, the density of residential, commercial and industrial developments is far less than that in Minneapolis. Further west in the communities of Minnetonka and Plymouth, the density of urban development becomes even less and urban planning to retain more park and open space is underway in anticipation of future growth.

The rapid growth of development in the Bassett Creek watershed is easily seen by comparing the current extent of development with that found on old aerial photographs and maps of the area. At the current rate of

growth, it can be expected that the watershed will be in a state of ultimate urbanization by 1990.

Commercial and industrial development is distributed throughout the Bassett Creek watershed. As urbanization has progressed westward through the watershed, commercial and industrial areas have developed along major highways and rail transportation facilities. Retail shopping centers are distributed throughout the watershed and provide convenient and diversified shopping locations for the residents of the watershed.

TRANSPORTATION

There is a high degree of flexibility in the location for residential and commercial development in the Twin Cities metropolitan area because of the diversified transportation system. Two major interstate highways serve the metropolitan area from outstate areas and an outer interstate ring circling the Twin Cities provides an efficient transportation link between suburban areas. Public transportation is provided by an extensive network of regular and express bus service routes which are operated by the Metropolitan Transit Commission. The Twin Cities area also is served by six major railroads, eight airlines, an extensive trucking system and barge service on the Mississippi and Minnesota Rivers.

PRESENT LAND USE

A land use study of the Bassett Creek watershed has been made using current land use zoning maps, recent aerial photographs and field verification procedures. The results of this land use survey are contained in Table 24 and Table 25. Of the 26,560 acres of the watershed, approximately 29% or 7,710 acres are presently undeveloped. The primary land use is residential comprising approximately 44% of the total watershed area. Commercial and industrial land use comprises approximately 12% or 3,240 acres of the watershed. Lands for parks, open space, public and semi-public use account for approximately 10% or 2,600 acres of the watershed area and approximately 1,320 acres or 5% of the total area within the watershed is

occupied by open water. Plate B-5 shows the existing land use for the Bassett Creek watershed.

Approximately 11% of the total area or about 2,685 acres are within the 100-year flood plain. The flood plain land uses are: residential, 21%; commercial-industrial, 9%; parks, open space, public and semi-public, 20%; open water, 40%; and undeveloped land, 10%.

FUTURE LAND USE

The future land use in the Bassett Creek watershed has been projected based on existing municipal land use plans. The future land use in the Bassett Creek watershed is summarized in Table 24 and Table 25. The primary future land use in the Bassett Creek watershed is residential comprising about 63% or 16,820 acres of the watershed. Residential land use will, therefore, increase by approximately 5,130 acres under future conditions. The second largest future land use is commercial-industrial which comprises approximately 4,725 acres or 18% of the watershed area. This represents an increase of approximately 1,500 acres from present land use. The future land use in the park, open space, public and semi-public category will be approximately 3,695 acres or 14% of the watershed area. Thus, it is projected that the land for parks, open space, public and semi-public use will increase by approximately 1,100 acres. The projected future land use for the Bassett Creek watershed is shown in Plate B-6.

TABLE 24

PRESENT AND FUTURE LAND USE IN THE

BASSETT CREEK WATERSHED

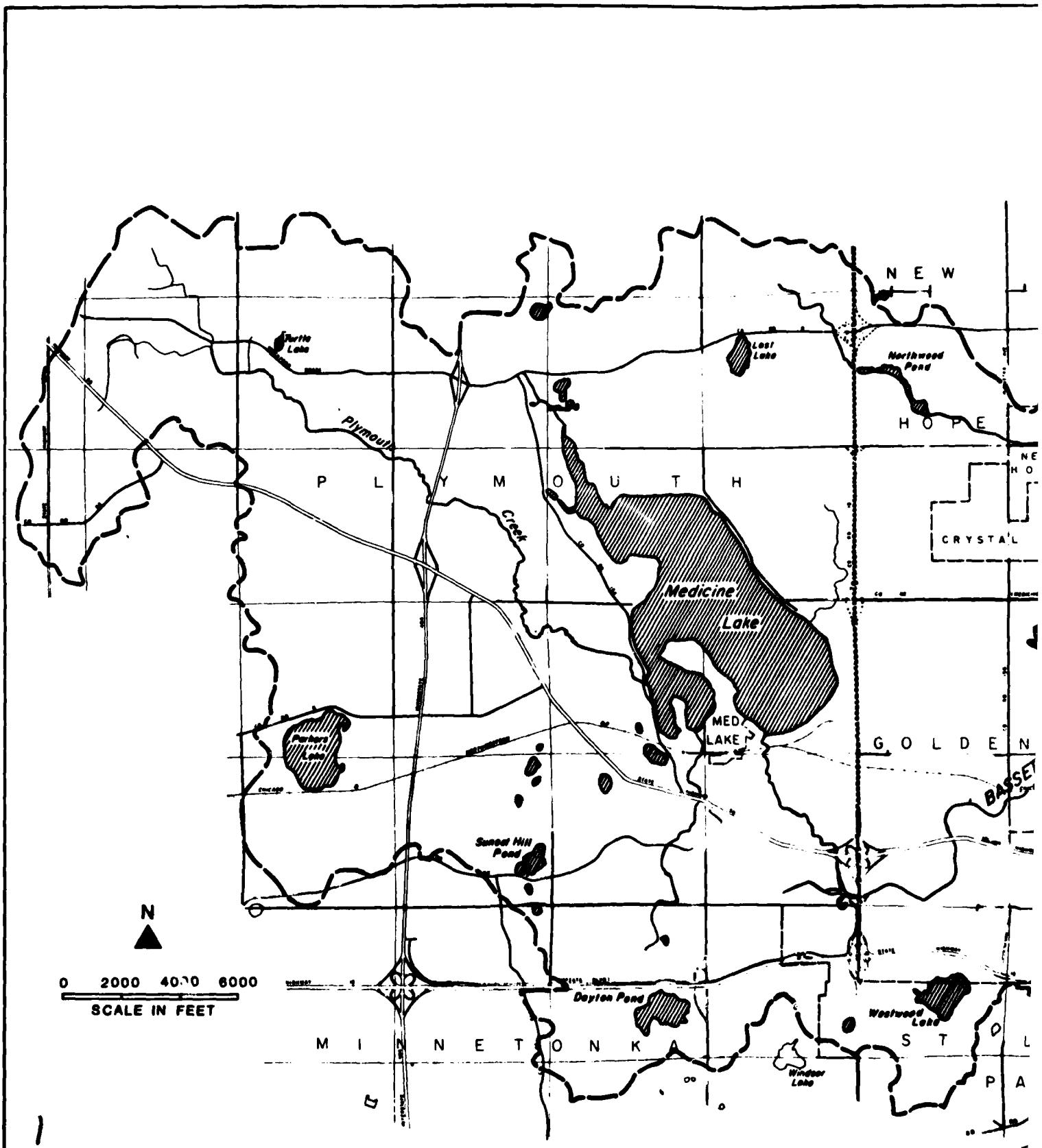
Land Use Category	Present Land Use acres	Future Land Use acres
Residential	11,690	16,820
Commercial-Industrial	3,240	4,725
Parks, Open Space, Public, Semi-Public	2,600	3,695
Open Water	1,320	1,320
Undeveloped	7,710	0
TOTAL	26,560	26,560

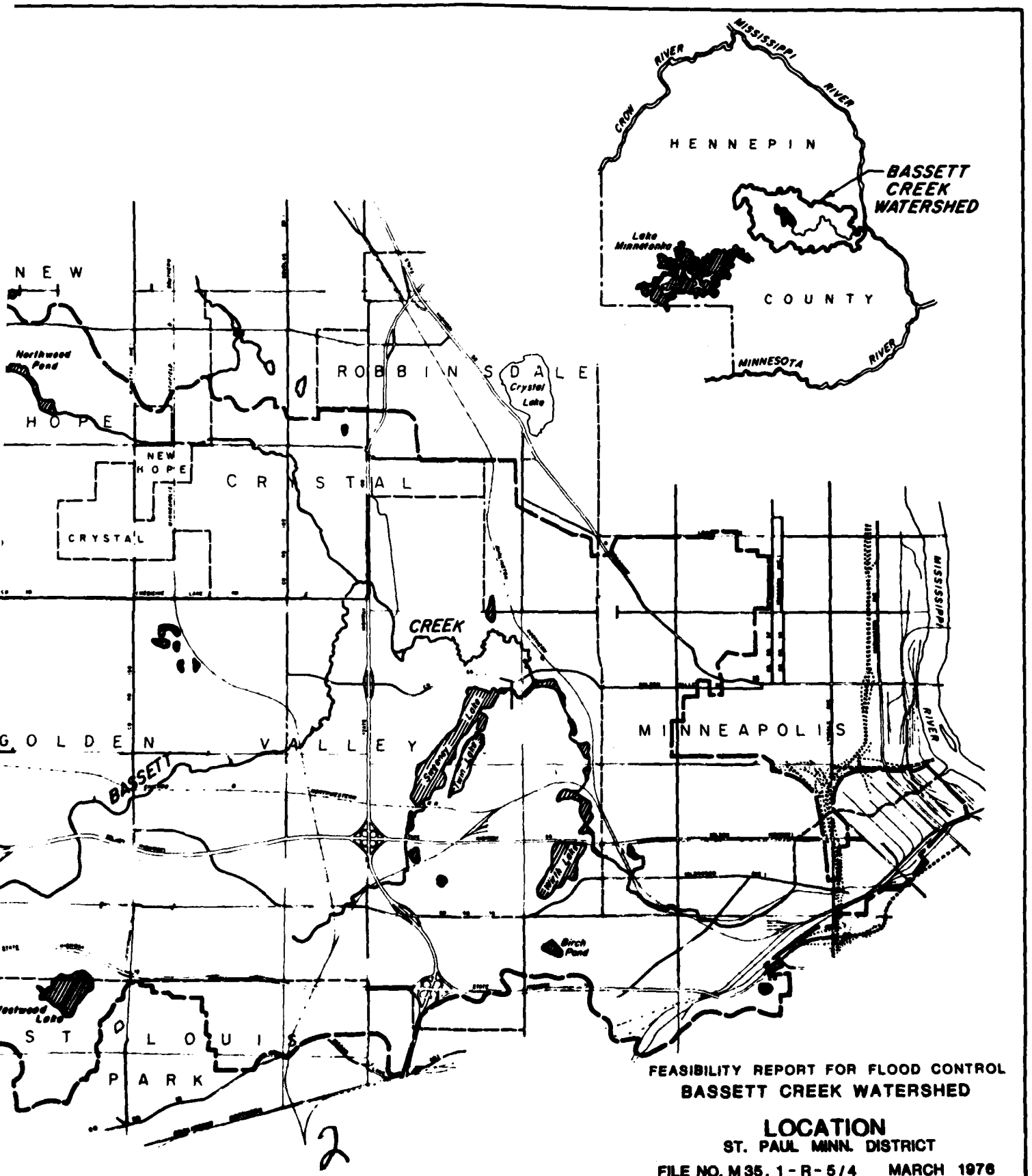
TABLE 25

PRESENT AND FUTURE LAND USE IN THE

100-YEAR FLOOD PLAIN

Land Use Category	Present Land Use acres	Future Land Use acres
Residential	570	700
Commercial-Industrial	235	315
Parks, Open Space, Public, Semi-Public	540	610
Open Water	1,060	1,060
Undeveloped	280	0
TOTAL	2,685	2,685


NEW
HOPE
PLYMOUTH
CRYSTAL
Medicine Lake
MEDICINE LAKE
GOLDEN
Parkers Lake
Sunset Hill Pond
Dayton Pond
Westwood Lake
Window Lake
MINNETONKA
Lost Lake
Northwood Pond
Creek
N
0 2000 4000 6000
SCALE IN FEET

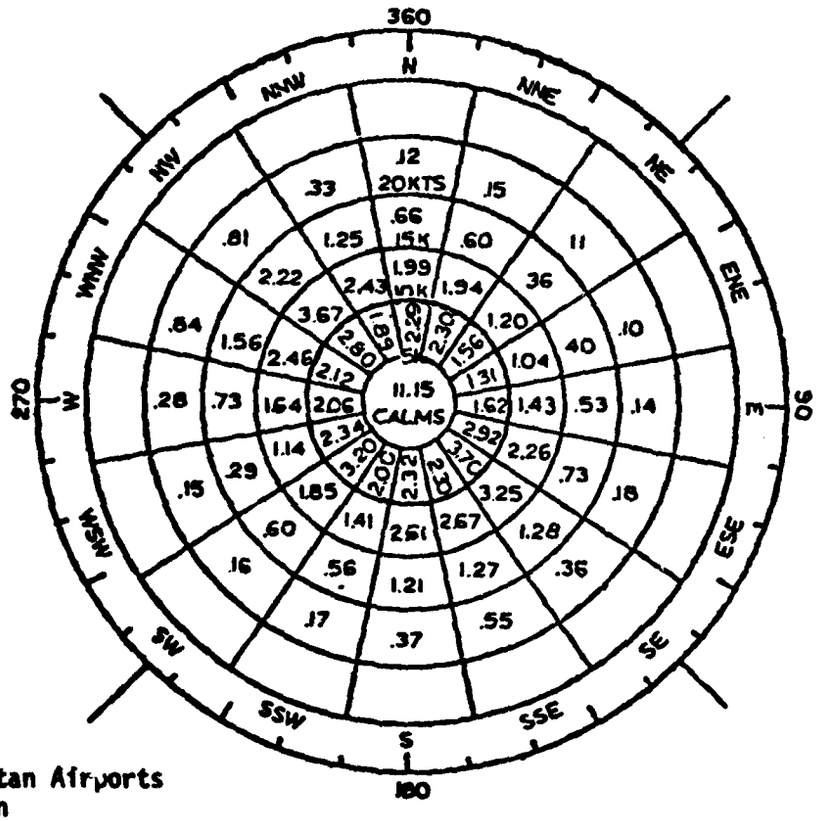


FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

LOCATION
ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/4 MARCH 1976

PLATE B-1



-Source:

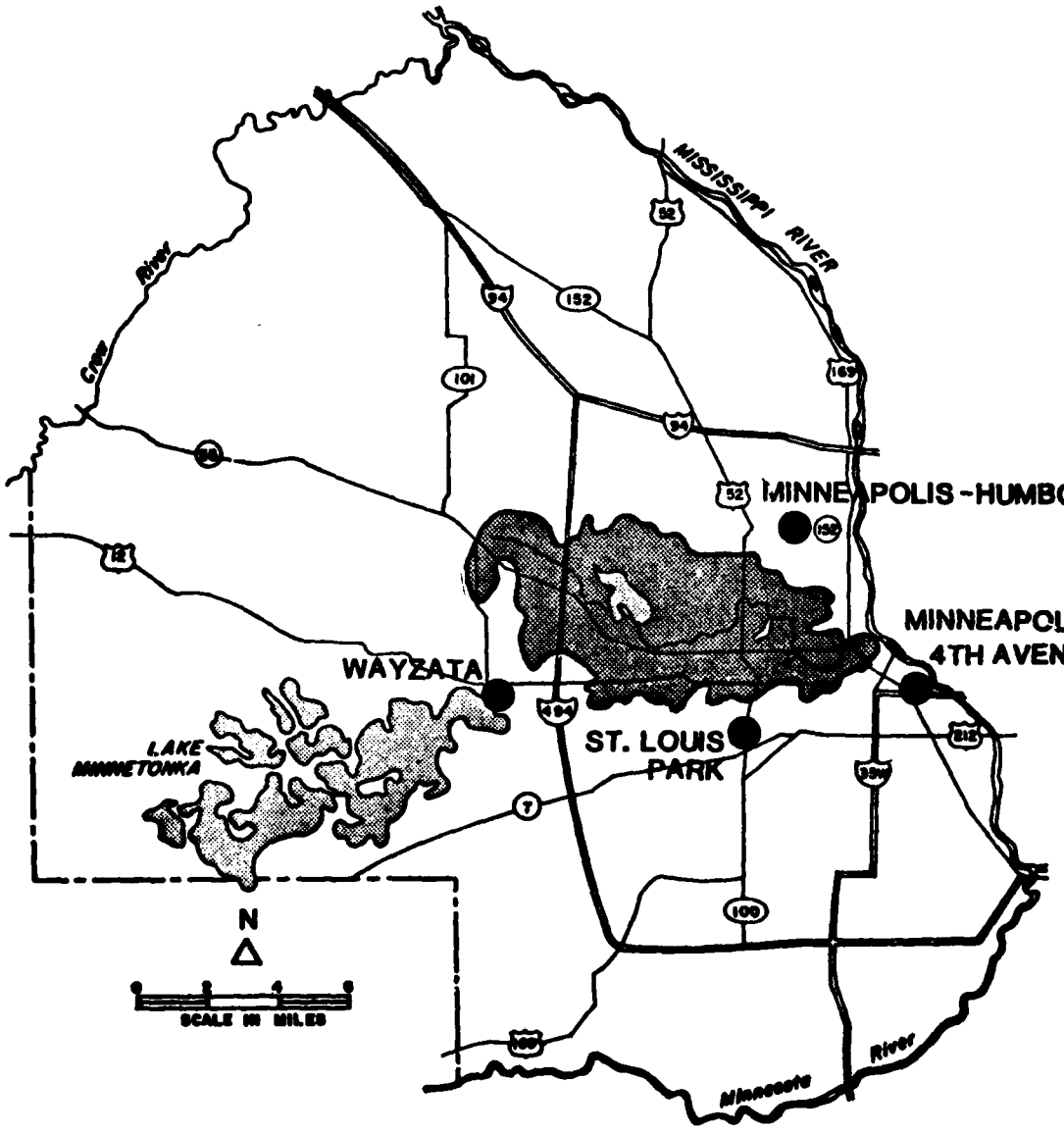
Metropolitan Airports Commission

FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

WIND ROSE

ST. PAUL, MINN. DISTRICT
FILE NO. M 35.1-R-5/5 MARCH 1976

PLATE B-2



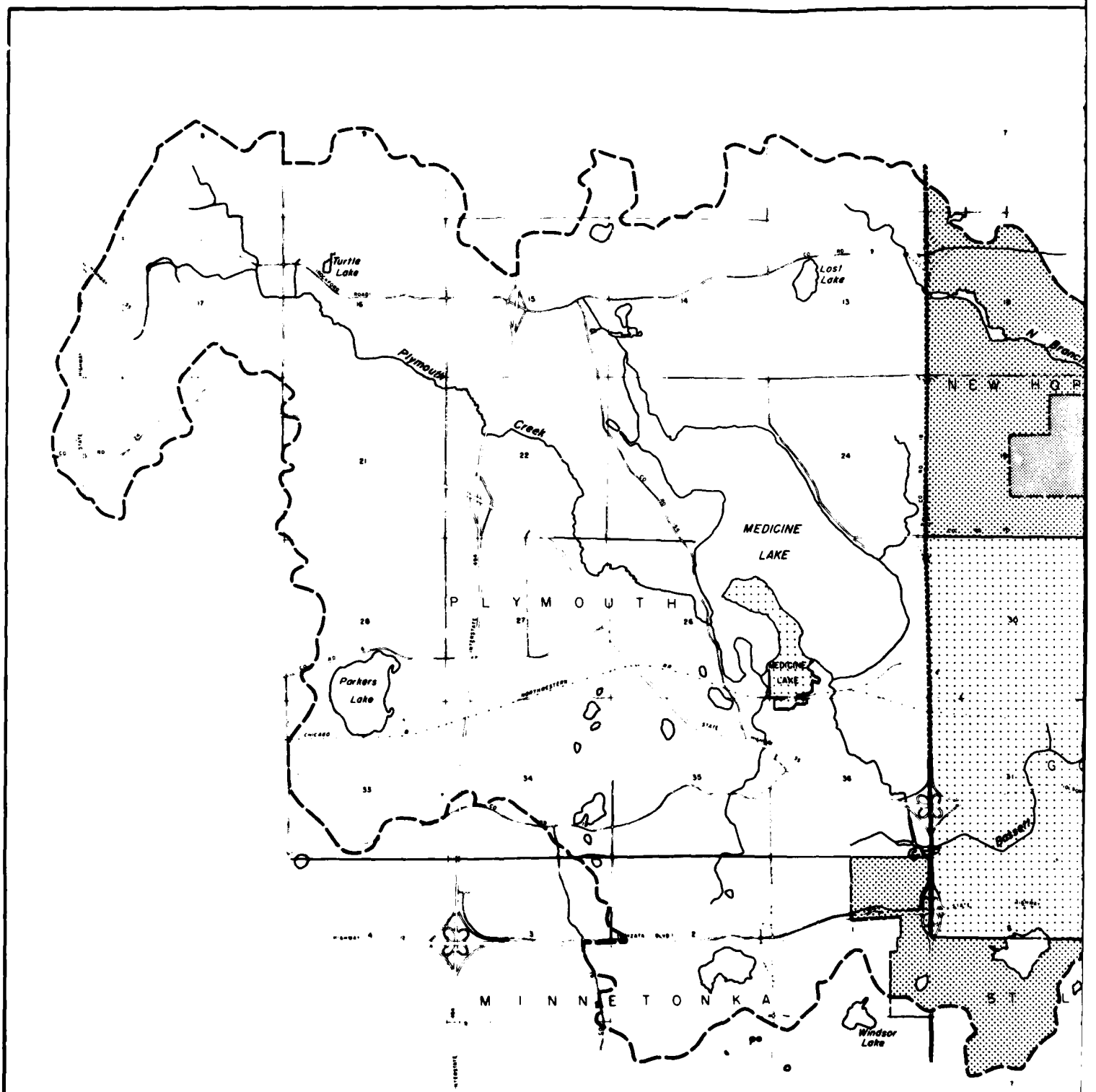
AIR QUALITY SAMPLING STATIONS ●

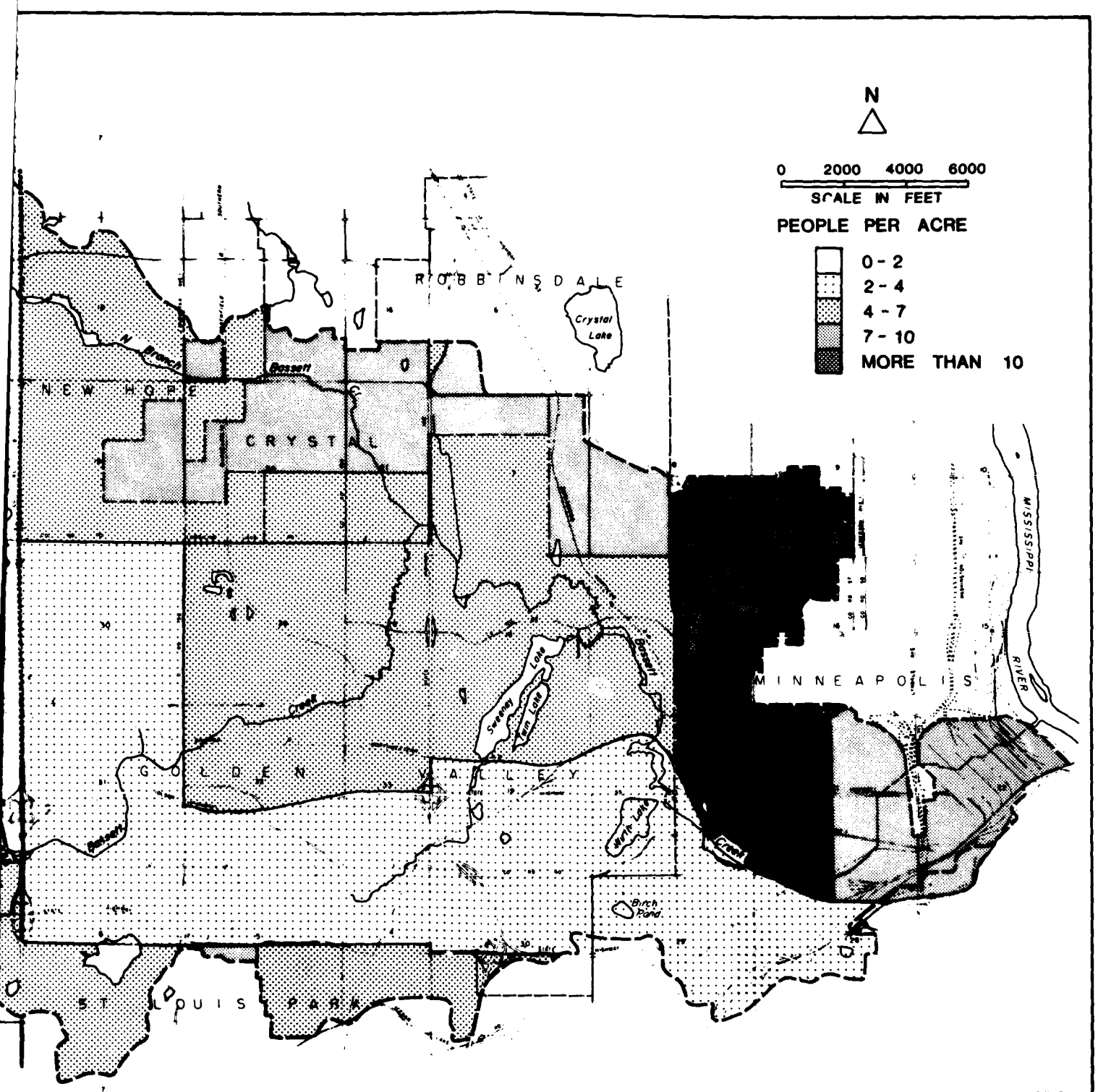
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

AIR QUALITY SAMPLING STATIONS

ST. PAUL, MINN. DISTRICT
FILE NO. M 35.1-R-5/6 MARCH 1976

PLATE B-3


Turtle Lake
Lost Lake
Plymouth Creek
MEDICINE LAKE
PLYMOUTH
Parkers Lake
MEDICINE LAKE
Bassett
MINNETONKA
Windsor Lake



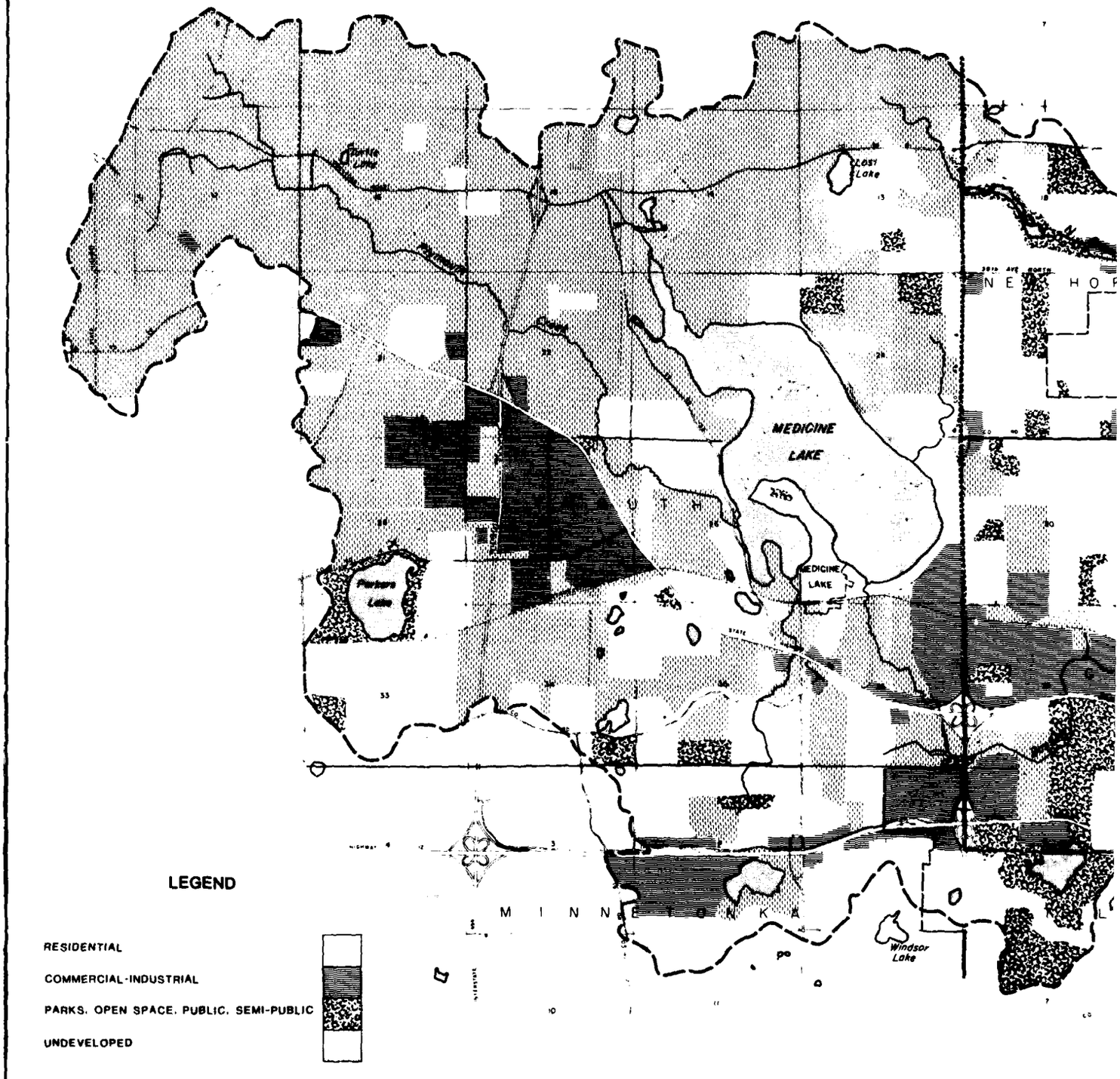
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

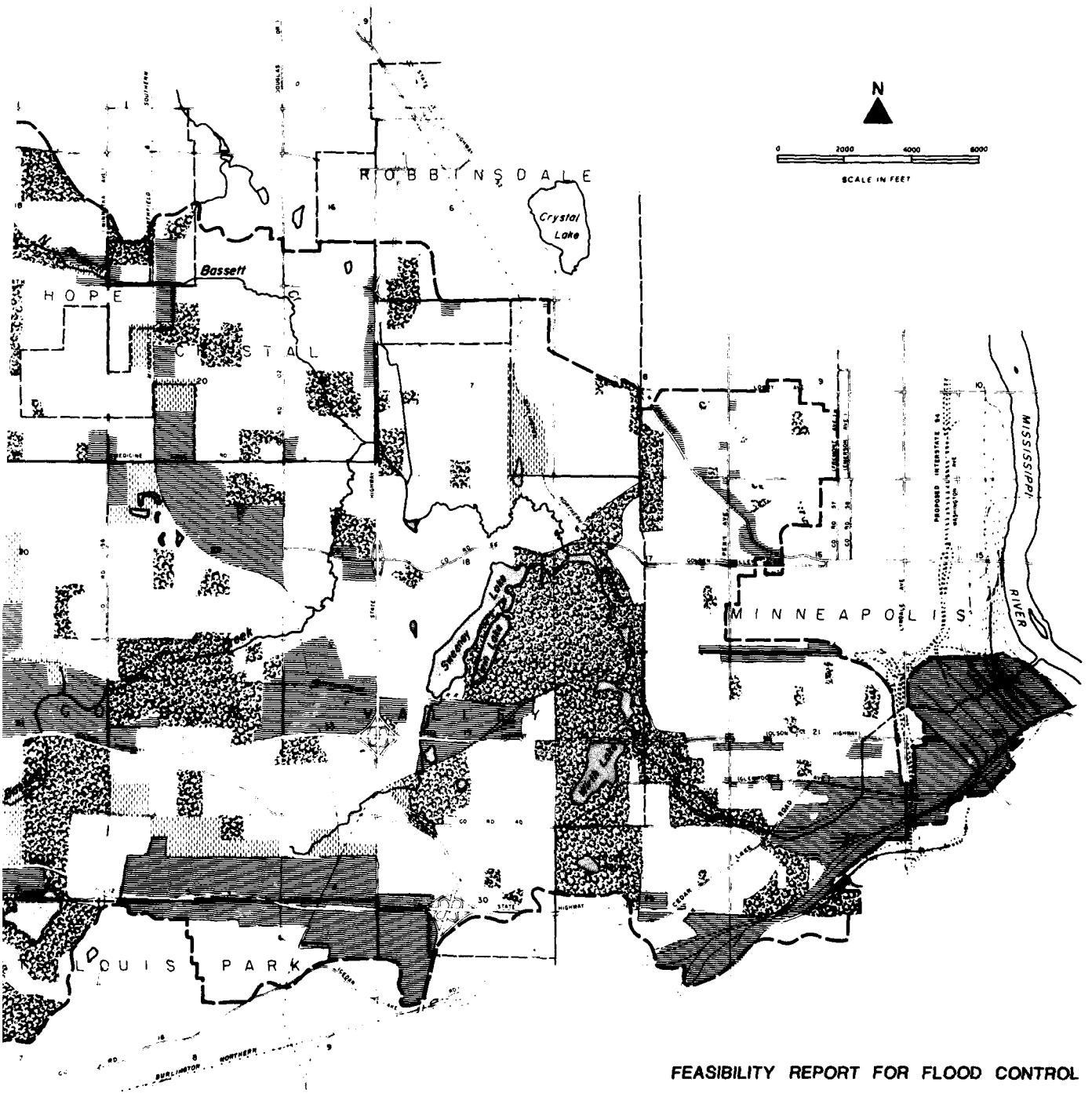
2

POPULATION DENSITY

ST. PAUL MINN. DISTRICT
FILE NO. M35.1-R-5/7 MARCH 1976

PLATE B-4


MEDICINE LAKE
MEDICINE LAKE
Lost Lake
Windsor Lake
LEGEND
RESIDENTIAL
COMMERCIAL-INDUSTRIAL
PARKS, OPEN SPACE, PUBLIC, SEMI-PUBLIC
UNDEVELOPED



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

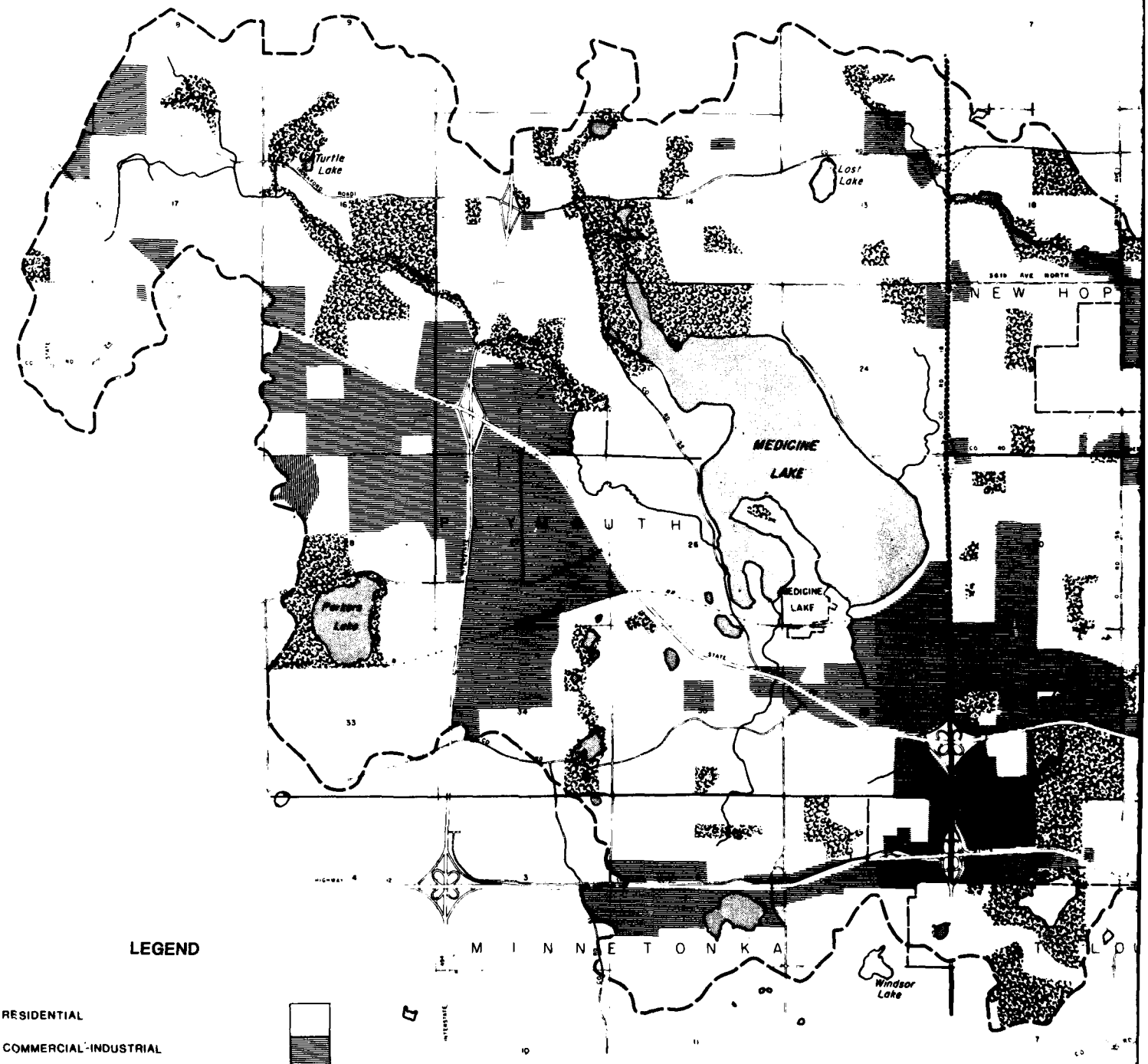
EXISTING LAND USE

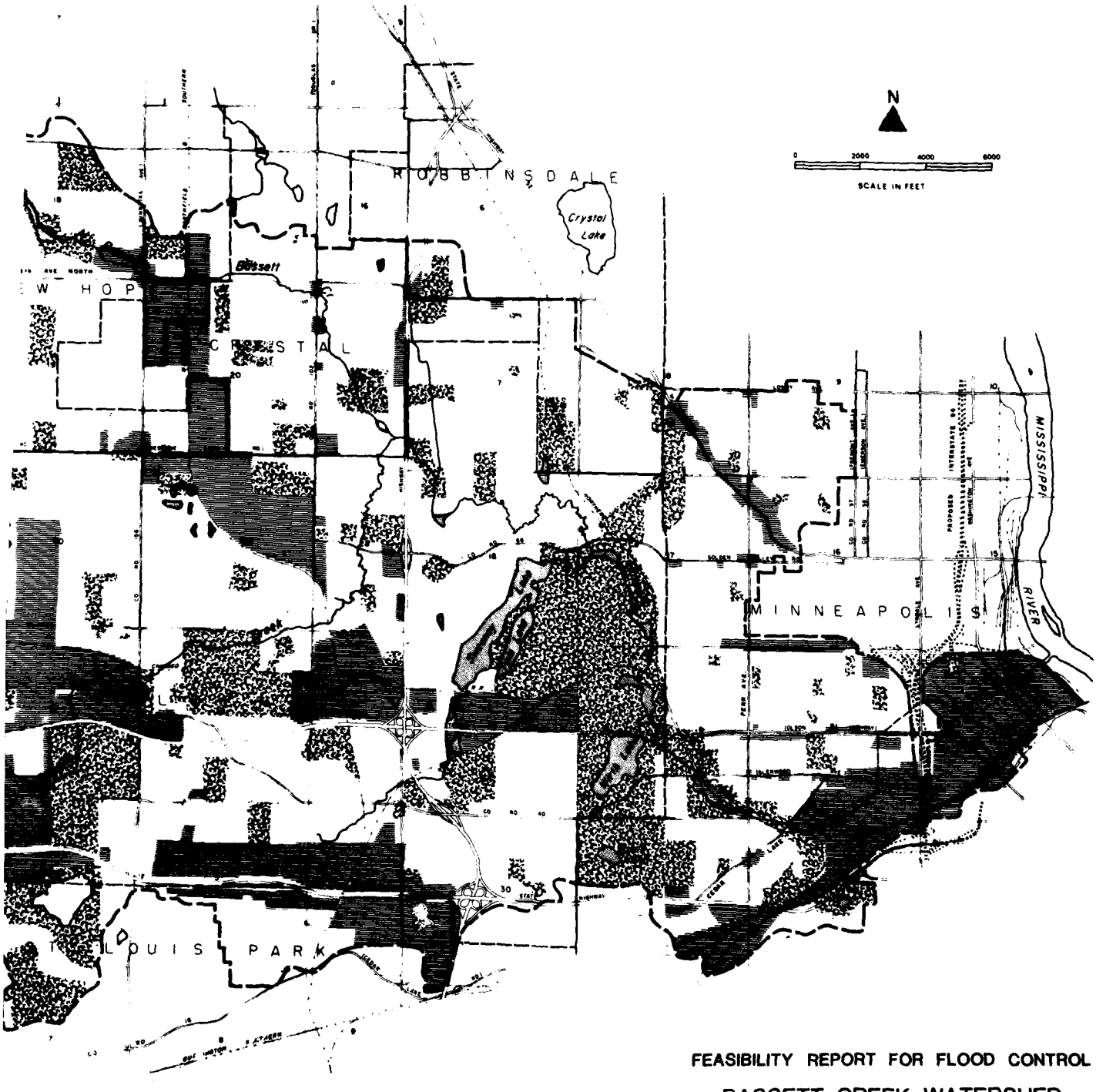
ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/8 MARCH 1976

2

PLATE B-5


Turtle Lake
Lost Lake
MEDICINE LAKE
MEDICINE LAKE
Parkers Lake
Windsor Lake
NEW HOP
M I N N E T O N K A
LEGEND
RESIDENTIAL
COMMERCIAL-INDUSTRIAL
PARKS, OPEN SPACE, PUBLIC, SEMI-PUBLIC



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

FUTURE LAND USE

2

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/9 MARCH 1976

PLATE B-6

SECTION C

PROBLEMS AND NEEDS

PROBLEMS AND NEEDS

Table of Contents

Item	Page
INTRODUCTION	C-1
FLOODING	C-1
FLOODS OF RECORD	C-2
PRESENT FLOOD DAMAGES	C-4
FUTURE FLOOD DAMAGES	C-4
WATER SUPPLY AND WATER QUALITY	C-5
PARKS AND RECREATION	C-6
STREAM BANK EROSION	C-8
PUBLIC HEALTH AND SAFETY	C-8
FISH AND WILDLIFE	C-9
EXISTING PROJECTS	C-9
IMPROVEMENTS DESIRED	C-11

SECTION C

PROBLEMS AND NEEDS

The problems and needs of the Bassett Creek watershed to which this study has addressed itself are discussed in this report section. The flood problems, floods of record, existing and future flood damages and existing projects and improvements are discussed in considerable detail. Additional coverage as related to the specific areas where flood control improvements are to be recommended will be given in subsequent report sections. The discussion also includes the related needs of water quality, water and land-based recreation, and fish and wildlife conservation as well as the improvements desired by the local interests.

FLOODING

The areas subject to frequent flooding include residential areas in the upper watershed and industrial and commercial lands in the lower watershed. Parks, golf courses and other recreational areas throughout the watershed are also subject to frequent flooding. The larger floods will inundate residential areas near the conduit entrance in addition to the industrial and commercial areas. Several major highways and railroads throughout the watershed will also be inundated. The large commercial and industrial area in Minneapolis is especially susceptible to flood damage because it is located immediately upstream of the 1.5 mile conduit which serves as an outlet for the entire Bassett Creek watershed. Only small flows can be carried by the existing conduit without inundating the surrounding commercial and industrial development. The existing conduit is in a state of general disrepair. Failure of any section of the conduit during a large flood or the accumulation of debris would further reduce the discharge capacity of the conduit, causing catastrophic flooding in the area of the conduit entrance.

Should debris accumulation or failure of any section of the existing conduit result in a 50% reduction in the discharge capacity during a

100-year flood event catastrophic flooding would occur in the area of the conduit entrance. The flood level would be increased by approximately 6 feet and inundate more than 250 acres. In addition to public properties and utilities, more than 450 residential dwellings and more than 80 industries would be flooded. The resulting flood damages would be in excess of $8 million.

FLOODS OF RECORD

Floods which have occurred on Bassett Creek have occurred both from summer rainstorms and spring snowmelt runoff. The large number of isolated flooding events which have occurred have been recorded in little or no detail. Residents have indicated that while most of the isolated instances of damaging floods along Bassett Creek have resulted from summer rainstorms, flooding has not been strictly limited to that cause.

A recent incidence of severe flooding in the Bassett Creek watershed occurred on 27 April 1975, as a result of a long duration spring rainstorm. Approximately 2-1/4 inches of rain fell in a 24-hour period throughout the watershed. Although this storm approximated a 1-year frequency rainfall event, its effects were probably comparable to a 25-year frequency runoff event due to antecedent conditions. A substantial spring snowmelt ended approximately 15 April and was followed by several days of moderate precipitation. As a result of the snowmelt and subsequent period of moderate precipitation prior to the 27th, the soils throughout the watershed were in a saturated condition and much of the natural upland depression storage was full prior to the rainfall event of 27 April. As a result of this storm, flood damage was incurred in Golden Valley, New Hope, Crystal and Minneapolis. A serious result of this storm was the damage incurred as a result of sanitary sewer backup into many homes in Golden Valley, New Hope and Crystal caused by excessive infiltration into wastewater collection facilities. In addition, many street intersections in the flood plain of Bassett Creek were inundated as a result of this storm.

Severe flooding occurred in the Bassett Creek watershed on 6 June 1974, as a result of an intense summer rainstorm. Approximately 3-1/2 inches of rain fell in a 6-hour period in the western portion of the watershed, while approximately 2-1/4 inches of rain fell in that 6-hour period in the eastern portions of the watershed. The most intense portions of the storm in the western portion of the watershed approximated a 25-year frequency rainfall event. As a result of this storm, flood damage was incurred in Golden Valley, New Hope, Crystal and Minneapolis. A more serious result of this storm was the damage incurred as a result of sanitary sewer backup in many homes in Golden Valley, Crystal and New Hope caused by excessive infiltration into wastewater collection facilities. In addition, many street intersections and low areas outside the flood plain of Bassett Creek were inundated as a result of this storm.

A more severe flood occurred in June, 1942. This flood was significant because of the damage which was incurred by the commercial and industrial establishments in Minneapolis. If a flood of this magnitude were to occur at this time, damages of approximately $1.6 million would occur in Minneapolis and damages of approximately $470,000 would be sustained throughout the remainder of the watershed.

On 5 September 1903, severe flooding occurred in Minneapolis in the area of the conduit inlet.[1] Reportedly, 5 inches of rain fell in 10 hours causing extensive flooding along Bassett Creek in North Minneapolis. Bassett Creek "overflowed its banks and some four hundred acres in the center of the city were flooded".[2] As the flood receded and "for weeks afterwards, the heavy fog and stench arising from this entire section, due to the decay (of) vegetation, was intolerable and must have been injurious to public health".[3] While this is the only information available

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[1] Report on the Feasibility of Diverting Bassett Creek Through the Lakes to Minnehaha Falls. Committee from the Minneapolis Real Estate Board, the West End Improvement Association, the Oak Lake Improvement League, the Linden Hills Improvement Association, the Calhoun Improvement Association, and the Oak Park Improvement Association, December 24, 1904.

[2] Ibid.

[3] Ibid.

regarding this flooding event, it is apparent that the impacts of this event on the residents of Minneapolis was significant.

If a flood having a 1% chance of occurring every year (100-year frequency) were to occur in the Bassett Creek watershed, approximately 2,700 acres, 222 residences and 18 industries would be flooded along the creek.

PRESENT FLOOD DAMAGES

Present flood damages include both tangible and intangible losses. Tangible losses suffered during floods include inundation damage to structures, utilities and transportation facilities, flood fighting costs, post-flood cleanup costs, business losses and increased expenses for normal operating and living during a flood situation. Intangible losses suffered include loss of life, human misery during a flood occurrence, disruption of normal community activities, potential health hazards from contaminated water and flood supplies, dislodged fuel storage tanks and flooding of sewage collection facilities. A detailed breakdown of present flood damages is presented in the report section entitled, "Impacts of the Selected Plan".

FUTURE FLOOD DAMAGES

Without flood protection in the Bassett Creek watershed, all tangible and intangible flood losses now occurring could occur on an increased scale in the future. Changes in the type and extent of flood damages will result from ongoing urban renewal program, land use shifts and continued residential, industrial and commercial development, where permitted by flood plain regulations. With increased urbanization of the watershed, flood damages will gradually increase at a rate proportional to improvements to existing public facilities, increase in property values and increased runoff. The value of the contents of the structures would also increase with time. Due to the flood plain regulations now being promulgated, vacant land in the flood plain will either be used for recreational purposes in the future or if developed, new structures will be flood proofed. In the interest of a

conservative projection, it is assumed in this analysis that the existing developed portion of the flood plain remains constant. These changes in future flood damages are explained more fully in the report section entitled, "Economic Impacts on the Selected Plan".

WATER SUPPLY AND WATER QUALITY

The City of Minneapolis withdraws approximately 77 million gallons of water per day from the Mississippi River for municipal and industrial water supply purposes. In addition, the City of Minneapolis supplies Golden Valley, Crystal and New Hope with water. Plymouth, Robbinsdale, Minnetonka, St. Louis Park and Medicine Lake obtain their water supplies from the Prairie-du-Chien-Jordan or the Mt. Simon-Hinckley bedrock aquifers. The dependence on these sources for municipal and industrial water supplies is not expected to change with increased future demand. At the present time, a coordinated effort to develop a detailed plan for the management, monitoring and development of the overall water resource system in the metropolitan area has not been made.

The water quality of the ground water available in the metropolitan area is generally good. The water ranges from moderately hard to hard and high iron and manganese concentrations are common. Recognized sources for ground water pollution include septic tank and cesspool seepage and industrial discharges. These sources have caused localized contamination of glacial drift aquifers and the uppermost bedrock aquifers.

The chemical quality of the surface water sources presently used for domestic water supply is generally good. Problems are limited to excessive hardness, turbidity and color. Although the surface waters are classified as moderately hard, hardness, iron and manganese concentrations tend to be somewhat lower than the available ground water sources. Bacteriological quality of surface water is substantially poorer than most ground waters and, in some cases, the raw water supply drawn by Minneapolis contains coliform organism counts in excess of the river standards established by the Minnesota Pollution Control Agency. This water is treated to meet

drinking water quality standards. Identified sources of surface water pollution in the vicinity of the metropolitan area include domestic and industrial waste from upstream areas, combined storm-sanitary sewer overflows, septic tank system seepage, runoff from agricultural lands and polluted runoff from urban areas.

Municipal wastewater in the Bassett Creek watershed is collected by a system of wastewater interceptors and is treated at the Metropolitan Wastewater Treatment Plant at Pigs Eye on the Mississippi River or at the Blue Lake Treatment Plant on the Minnesota River. These collection facilities and treatment plants are operated and maintained by the Metropolitan Waste Control Commission. Stormwater is collected by separated storm sewer systems except in portions of Minneapolis where the separation of the combined storm and sanitary sewer system is currently in the initial stages. In the municipalities of Golden Valley, Crystal and New Hope, periods of intense rainfall have in the past resulted in sanitary sewer backup problems caused by excessive infiltration into wastewater collection facilities. The Metropolitan Waste Control Commission and the municipalities involved are taking action to correct this problem.

The water quality in Bassett Creek is subject to seasonal variation. The water quality monitoring program conducted by the Bassett Creek Flood Control Commission has indicated the seasonal variation in sampling parameters, with the summer months demonstrating increased fecal coliform counts which do not meet the Minnesota Pollution Control Agency's 2B Stream Standard (Minn. Reg. WPC 14). The 2B Standard requires water of adequate quality to propagate and maintain both sport and commercial fishes as well as aquatic recreation of all kinds including swimming. The water quality monitoring program currently being undertaken by the Bassett Creek Flood Control Commission is intended to locate the sources of contamination and, with the cooperation of the MPCA, improve the existing water quality.

PARKS AND RECREATION

The several major parks in the watershed offer a wide variety of recreational facilities and opportunities. Brookview Community Golf Course,

the Hollydale Golf Course, and the Theodore Wirth Golf Course are public facilities, and in addition, two private golf courses are located in the watershed. In the winter, cross-country skiing, downhill skiing, and sledding are also popular in Theodore Wirth Park and several of the community parks throughout the watershed. Wirth Lake, Sweeney Lake, Twin Lake and Medicine Lake offer opportunities for fishing, boating, sailboating and canoeing. The total area of park and publically owned open space in the watershed exceeds 1,400 acres and the total water surface area of the major lakes is approximately 1,200 acres.

Generally the recreational facilities available to the general public in Hennepin County are adequate to meet existing needs. However, studies have shown that to remain adequate, the rate of development and acquisition of park land must keep pace with the increasing population. In the Bassett Creek watershed, there appears to be a general lack of local recreational facilities geographically spaced so that they are readily accessible to people with limited transportation. In the more densely developed portions of the watershed, separated bikeways and natural areas for studying and enjoying the natural environment are few. In areas where existing development is scattered, many local recreation facilities have not been developed at this time, thus creating a temporary and artificial limitation on the geographical spacing of these facilities. As development pressure requires the development of future facilities, this geographical limitation will be significantly reduced.

In Minneapolis, a large portion of the property immediately adjacent to Bassett Creek is publicly owned, except where the creek flows in the conduit, and access to the creek exists at several points. Although a developed recreational trail does not exist at the present time, the Bassett Creek Valley through Minneapolis could be developed to link bike and walkways along Wirth Parkway and the Bryn Mawr Meadows Park, providing a potential trail system of approximately 2.5 miles. In other portions of the watershed, private property abuts the creek and the potential for hiking and walking along the creek is restricted to short reaches. Separated bikeways and walkways have been planned and are being developed

in Golden Valley and Plymouth, however, only short sections of the proposed trails follow the creek.

STREAM BANK EROSION

Throughout the Bassett Creek watershed, the increased normal flows and flood flows resulting from continued urbanization of the watershed have caused increased erosion and subsequent siltation problems. As urbanization of the watershed continues in the future, increased normal flows and flood flows will result in further increases in the erosion and subsequent siltation of the stream bed. These increased flows will cause the creek to increase its tendency to meander through the flood plain and will affect the existing natural and unnatural vegetation along the channel banks. In some areas of the watershed this increased tendency to meander has become readily apparent in recent years. In some reaches, the root systems of trees along the edge of the channel have been undermined by flowing water causing the trees to lean over the channel and eventually die. In some reaches of the creek where residential properties abut the creek, residents have expressed concern because of the erosion of the stream bank, the loss of portions of their lawns and in some instances, the movement of the channel causing the loss of portions of their usable property. This loss of vegetation and trees along the channel bank caused by the tendency of the creek to meander can be expected to increase in the future.

PUBLIC HEALTH AND SAFETY

The health and safety of residents in the study area are directly affected during major flood periods. No flood-related deaths are known to have occurred, but a serious threat to life and limb is always present during flood periods due to flooded residences and the related potential for electrical shock and injurious falls and due to attempted movement over flooded thoroughfares. Other previously experienced and future threats to public health and safety include impediment of local traffic, vermin from flooded areas, contamination of private water supplies, damage to water supply distribution systems, damage to wastewater collection

facilities, and increased disease vector production during a major flood. Isolation of areas by floodwaters could also create hazards in terms of supplying emergency medical, fire and law enforcement services. The potential for a fuel spill in the vicinity of the conduit inlet is always present during major floods due to the possible dislocation of the numerous fuel storage tanks in that area.

FISH AND WILDLIFE

The Bassett Creek watershed contains ample resources for recreational and sport fishing. Fish populations vary from lake to lake due to the diversity and quality of habitat available. Four of the five major lakes in the watershed are known to provide bass, panfish and some northern pike angling. Bassett Creek along with the smaller lakes and ponds contains carp, bullheads, sunfish and a variety of minnows. The migration of rough fish from the Mississippi River into Bassett Creek and the lakes and ponds throughout the watershed, provides undesirable competition for the more desirable game fish species. Certain rough fish species can cause excessive turbidity problems due to the bottom feeding habits. While the extent of the turbidity levels in the creek or lakes and ponds in the watershed which is attributable to rough fish is unknown, continued migration of rough fish can be expected to increase the problem in the future.

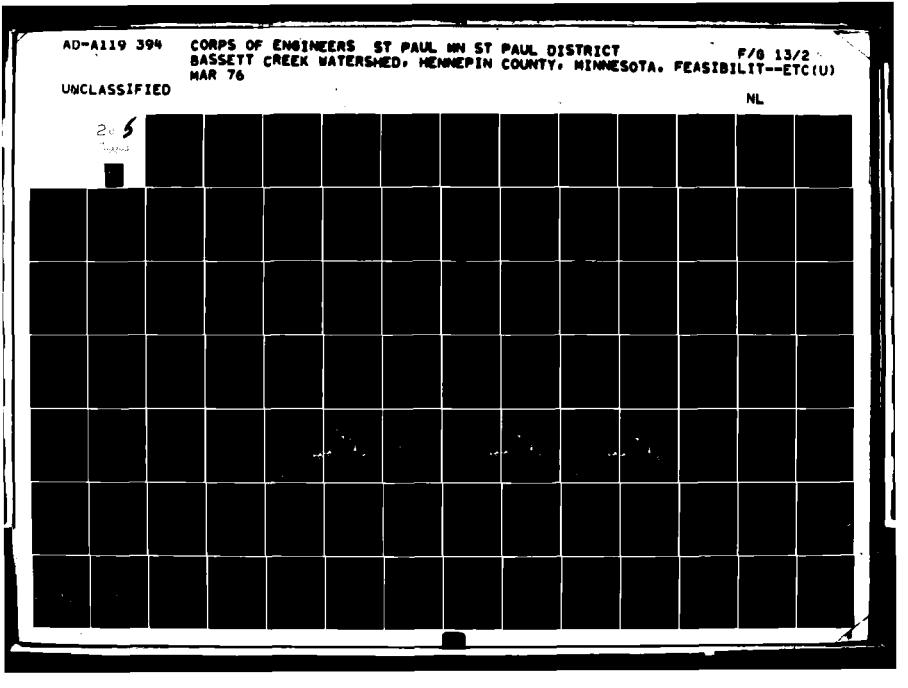
Due to the extensive urbanization of the watershed, wildlife habitat is limited. As urbanization continues, this habitat will be further reduced and the wildlife population will generally be limited to waterfowl, birds and smaller mammals and amphibians and reptiles. There is a need to maintain and enhance those areas which provide wildlife habitat.

EXISTING PROJECTS

There are no existing Federal flood control projects located in the Bassett Creek watershed. The fixed spillway lake level control dam on Medicine Lake restricts the outlet capacity of the lake and provides approximately 2,400 acre-feet of storage at its 100-year flood level. A lake level control structure on Sweeney Lake and the downstream crossings

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restrict the discharge capacity to the main stem and provide approximately 500 acre-feet of storage at the 100-year level. A weir and outlet pipe on Northwood Lake restricts the discharge on the North Branch of Bassett Creek and provides approximately 320 acre-feet of storage at the 100-year flood level. The purpose of these control structures is to maintain the normal lake levels during nonflood periods.

The existing crossings of Bassett Creek restrict flood flows and provide substantial inundation storage which significantly reduces the major flood peaks. The locations of significant areas of existing inundation storage are the Brookview Community Golf Course (300 acre-feet), Bassett Creek Park (85 acre-feet), Rice Lake (250 acre-feet), and Theodore Wirth Park (400 acre-feet).

In Minneapolis, a 1.5 mile underground conduit serves as the outlet for the entire Bassett Creek watershed. Bassett Creek enters the conduit near Second Avenue North and Dupont Avenue North and outfalls from the conduit into the Mississippi River above the Upper St. Anthony Lock and Dam near River Mile 855. As urbanization progressed along the creek in Minneapolis, the conduit was constructed in a piece-meal fashion from the Mississippi River to its existing inlet. The route of the existing conduit through Minneapolis is shown on Plate D-2. Portions of the tunnel were constructed prior to 1900 and its cross-sectional area changes many times throughout its length, restricting the discharge capacity and providing obstructions for the accumulation of debris. The top of the tunnel inlet is well above the surrounding low areas and in order to flow full, the surrounding commercial and industrial development must be flooded. Only small flows can be carried by the existing conduit without inundating the surrounding commercial and industrial development. The existing conduit is in a state of general disrepair. In the concrete portions of the tunnel, there are several areas where the reinforcing steel has been exposed by the deterioration of the concrete surfaces. Where the conduit is constructed of sandstone block, the mortar joints have deteriorated. Failure of any section of the conduit during a flood or the accumulation of debris would further reduce the discharge capacity of the conduit, causing catastrophic flooding in the area of the inlet.

The municipalities are responsible for the maintenance of the flood control structures within their boundaries. This includes the lake level control structures, the existing conduit and all municipal street crossings. The Hennepin County Highway Department is responsible for the maintenance at all county road crossings and the Minnesota Highway Department is responsible for the maintenance at all state highway crossings.

IMPROVEMENTS DESIRED

Public meetings were held in many of the municipalities within the Bassett Creek watershed during the preliminary Flood Control Feasibility Study to inform the public of the flood potential in the watershed, to review the options available for flood control, and to discuss the needs and desires of the people. Suggested solutions to the flood problem included a moratorium on future building in the flood plain and removal of all existing buildings in the flood plain, diversion of flood flows to Cedar Lake and Sweeney Lake, increased flood storage on Medicine Lake, cooperative drainage facilities with those proposed by the Minnesota Highway Department, and deep bedrock tunnels. The possibility of providing an open channel to the Mississippi River in place of the existing conduit was also suggested by local interests. The City of Minneapolis has initiated a study to review existing land use in the area of the existing conduit to determine if an open channel in this area would enhance a redevelopment plan.

It was suggested that consideration be given to the use of flood plain areas for recreational purposes. Because of the lack of trails and hiking areas along the creek in Minneapolis, it was also suggested that enough area be provided along an open channel through Minneapolis for walkways and other leisure activities. Residents in Golden Valley indicated that temporary flood storage on existing public property such as parks and golf courses would provide for the multiple use of those properties and would generally be acceptable. Local interests generally indicated that channel modifications and realignments are unacceptable and, wherever possible, the creek should be left in its existing state.

Public informational workshops were held in eight of the nine municipalities within the Bassett Creek watershed during this Phase II Study to inform the public of the options available for flood control and to discuss the needs and desires of the people. The comments and concerns of the citizens who attended these workshop meetings to features in various flood control alternative plans has helped to identify those flood control features which are compatible with the desires of the people of the watershed. These local interests indicated that the removal of homes which are currently within the flood plain should be avoided wherever possible and that generally, channel modifications and realignments were unacceptable and should be avoided whenever possible. In addition, local interests expressed concern regarding the erosion potential of the creek throughout the watershed and expressed the need for improving the water quality of the creek, the need for clearing debris and rubbish from the creek and its banks and the need for orderly maintenance of the creek corridor. The local interests objected to any plan that would impair the aesthetics of the creek.

The needs of the watershed with regard to water supply and water quality problems are being considered under programs of other federal, state, county and local governmental agencies as well as the Bassett Creek Flood Control Commission. This report concentrates on meeting the flood control and associated needs, including recreation and fish and wildlife.

SECTION D

PLAN FORMULATION

PLAN FORMULATION

Table of Contents

Item	Page
INTRODUCTION	D-1
PLAN FORMULATION OBJECTIVES	D-1
FORMULATION AND EVALUATION CRITERIA	D-2
TECHNICAL CRITERIA	D-3
ECONOMIC CRITERIA	D-3
ENVIRONMENTAL CONSIDERATIONS	D-4
SOCIAL WELL-BEING CONSIDERATIONS	D-5
POSSIBLE SOLUTIONS	D-5
NONSTRUCTURAL ALTERNATIVES	D-7
NO ACTION--MAINTAIN BASE CONDITION (Alternate 1)	D-7
PERMANENT FLOOD PLAIN EVACUATION (Alternate 2)	D-11
FLOOD PROOFING AND PARTIAL EVACUATION (Alternate 3)	D-12
STRUCTURAL ALTERNATIVES	D-13
FLOOD STORAGE AND CHANNEL MODIFICATION WITH REPAIR OF EXISTING CONDUIT (Alternate 4-A)	D-15
FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 4-B)	D-18
FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 4-C)	D-19
FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 4-D)	D-20
FLOOD STORAGE AND CHANNEL MODIFICATION WITH AN OPEN SPACE-OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 4-E)	D-21
FLOOD STORAGE AND DIVERSION WITH REPAIR OF EXISTING CONDUIT (Alternate 5-A)	D-22

Table of Contents (Continued)

Item	Page
FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 5-B)	D-25
FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 5-C)	D-25
FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 5-D)	D-26
FLOOD STORAGE AND DIVERSION WITH AN OPEN SPACE-OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 5-E)	D-26
COMBINATIONS OF NONSTRUCTURAL AND STRUCTURAL ALTERNATIVES	D-27
FLOOD STORAGE AND FLOOD PROOFING WITH REPAIR OF EXISTING CONDUIT (Alternate 6-A)	D-27
FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 6-B)	D-29
FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-C)	D-30
FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-D)	D-30
FLOOD STORAGE AND FLOOD PROOFING WITH AN OPEN SPACE-OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 6-E)	D-31
OTHER ALTERNATIVES CONSIDERED	D-31
EVALUATION OF ALTERNATIVES	D-33
ALTERNATIVES SELECTED FOR FURTHER ANALYSIS	D-38
CONTRIBUTIONS OF ALTERNATIVES TO NATIONAL OBJECTIVES	D-40
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN	D-42
ENVIRONMENTAL QUALITY (EQ) PLAN	D-42

Table of Contents (Continued)

Item	Page
DEVELOPMENT OF SELECTED PLAN	D-46
COMPARISON OF IDENTIFIED PLANS	D-47
SCALE OF DEVELOPMENT	D-48

List of Tables

ECONOMIC IMPACTS OF FLOOD DAMAGE REDUCTION ALTERNATIVES FOR THE BASSETT CREEK WATERSHED	D-36
RANKING OF ALTERNATIVES.	D-41
PLAN OPTIMIZATION SUMMARY	D-48
SYSTEM OF ACCOUNTS	Follows D-48

Plates

Plate No.	
D-1	FLOOD STORAGE AND CHANNEL MODIFICATION ALTERNATIVE
D-2	OUTLET ALTERNATIVES
D-3	DIVERSION AND FLOOD STORAGE ALTERNATIVE
D-4	FLOOD STORAGE AND FLOOD PROOFING ALTERNATIVE
D-5	MAXIMIZATION OF NET TANGIBLE BENEFITS

SECTION D
PLAN FORMULATION

The citizens of the Bassett Creek watershed have recognized the potential flood related economic losses and human misery which may occur in the future. For several years, protection from these potential losses has been sought. Meeting the watershed's related needs, where they are consistent with existing development and land use plans, is considered to be equally important. Other needs which have been identified require attention in the development of a plan. Plan formulation involves the identification and development of various flood control measures into viable plans, evaluating and screening of plans and the eventual development of a comprehensive plan. The basic objective of the plan formulation process is to develop a plan which will provide the best use or combination of uses of water and related land resources to meet all foreseeable short- and long-term needs in the watershed. In pursuit of this general objective, components of two national planning objectives (National Economic Development and Environmental Quality) for the Bassett Creek watershed must be identified. These components are specific segments of the objectives identified as pertinent in the study area. Plans which satisfy the components must then be developed.

PLAN FORMULATION OBJECTIVES

Alternatives are developed using a list of planning objectives defined for the area. The list serves as a guideline for the development of alternatives which are capable of satisfying some or all of these objectives. It is important for the alternatives developed to be realistic and not represent extreme conditions.

In the study of flood and related problems in the Bassett Creek watershed, the following specific planning objectives have been identified:

a. Any plan developed must preserve to the maximum extent possible the quality of the stream environment throughout the watershed

and must be coordinated with local beautification planning studies.

b. The plan must provide flood damage reduction or compensation for losses to a degree acceptable to the people being protected Protection from a one percent chance flood is considered the minimum degree of protection acceptable.

c. The plan must be socially acceptable to the people being protected and must be acceptable to the local sponsor.

d. The plan must enhance the economic welfare of the local people and add to their security and well-being.

FORMULATION AND EVALUATION CRITERIA

The various impacts of the alternatives developed are identified by comparing the base condition existing and projected to that of the estimated project condition with an alternative. In this study, the base condition is one of flood plain regulation and flood insurance for most of the flood prone areas in the watershed[1]. For the analysis and comparison of alternatives and for eventual selection of basin plans, a standard set of criteria is used to compare the alternatives considered with the base condition. Criteria were considered under the major categories:

a. Technical
b. Economic
c. Environmental
d. Social Well-Being

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[1]Currently, all of the communities in the watershed have adopted or are in the process of adopting flood plain regulations and all of the communities in the watershed, except Medicine Lake, have joined the National Flood Insurance Program.

TECHNICAL CRITERIA

The following technical criteria were adopted for use in formulating a plan.

a. The plan must be technically feasible to implement based on appropriate engineering standards and guidelines.

b. The plan would provide as a minimum protection against a flood having a recurrence interval of once in 100 years occurring over the watershed with expected ultimate urbanization.

c. Where feasible, the plan should provide protection against the standard project flood, or at least within the freeboard range of proposed improvements.

ECONOMIC CRITERIA

Economic criteria applied in formulating a plan are those included in Senate Document #97, 87th Congress, entitled "Policies, Standards, and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources". Economic criteria used in evaluating each alternative plan include the following:

a. Generally, tangible benefits exceed project economic costs. However, in certain instances, consideration of appropriate gains in environmental quality, social well-being, and regional development could reverse this condition.

b. Each separable unit or purpose provides benefits at least equal to its cost.

c. The scope of the proposed development is scaled to provide maximum net economic benefits. However, proposed developments

providing less than the economic optimum can be recommended if appropriate gains in environmental quality and social well-being can be shown.

d. A plan, if undertaken, will not preclude the development of a more economical means, when evaluated on a comparable basis, of accomplishing the same purpose(s). This limitation applies only to those alternative possibilities which would be physically displaced or economically precluded from development if the project were undertaken.

Annual benefits and costs for the alternative plans, where appropriate, are evaluated based on an economic life of 100 years, an interest rate of 6-1/8% and price levels and conditions prevailing in October, 1975.

ENVIRONMENTAL CONSIDERATIONS

Environmental factors, objectives and effects considered in the formulation and evaluation process include the following:

a. Management, protection, enhancement or creation of areas of natural beauty and human enjoyment.

b. Management, protection and enhancement of archaeological, historical, biological and geological resources and ecological systems.

c. Enhancement of quality aspects of water, land and air while recognizing the need to harmonize land use objectives in terms of productivity for economic use and development with conservation of the resource.

d. Study, development and description of appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative use of available resources.

e. Evaluation of the environmental impact of any proposed action, any adverse environmental effect which could not be avoided should a proposal be implemented and the alternatives to the proposed action.

f. The relationship between local short-term uses and the maintenance and enhancement of long-term productivity.

g. The irreversible and irretrievable commitment of natural resources and biological systems which could be utilized in any proposed action.

SOCIAL WELL-BEING CONSIDERATIONS

Social well-being factors considered in the study include the following:

a. Possible loss of life and hazards to health and safety of the people with and without project conditions.

b. Preservation and enhancement of social, cultural, educational and historical values in the area.

c. Preservation of pleasing, aesthetic values and other desirable environmental effects such as pleasing landscapes.

d. The plan must be consistent with the overall plan for water and related land resource management and development for the Upper Mississippi River Basin.

POSSIBLE SOLUTIONS

The solutions considered in this study to meet water and related land resource problems and needs in the Bassett Creek watershed, particularly for reduction of flood damages, were separated into three

principal categories: nonstructural measures including no action or maintaining the base condition of the watershed, structural measures, and possible solutions involving combinations of nonstructural and structural measures. The extent of study given to each potential solution was established by evaluating each for its physical, political, financial, technical, institutional, economic, environmental, and social feasibility. Potential solutions meeting these general guidelines were compared with other potential solutions to assure a coordinated watershed-wide plan. Structural flood control measures were considered to supplement or compliment nonstructural measures. Continuous coordination was maintained with Federal, State and local agencies having related programs or interests in the area in the identification and evaluation of potential solutions.

The need for preservation of the natural environment, including preservation of scenic areas and wildlife habitat, was evaluated, identified, and developed as an important part of any overall plan. While recreational needs do not appear to be significant in the Bassett Creek watershed, measures will be incorporated into any selected plan to meet these needs where appropriate.

Various nonstructural and structural flood control measures could reduce the potential for flood damage in the Bassett Creek watershed. Nonstructural measures include: no action--maintain base condition, permanent flood plain evacuation as a supplement to the base condition, and flood proofing and partial evacuation as a supplement to the base condition. Structural flood control measures for the watershed include combinations of flood storage, channel modification and diversion for the reach upstream of Irving Avenue. In addition, structural measures for the outlet reach from the Mississippi River to Irving Avenue include: repair of the existing conduit, a new conduit, and an open channel.

Generally, the reduction of potential flood damages along Bassett Creek using structural measures required that a combination of specific

structural features be used within a particular reach of the creek because of the urban nature of the creek and the development patterns along the creek. Therefore, the structural measures are designated according to their principal structural feature for ease of reference. Nonstructural and structural measures considered and their related technical, economic, social and environmental effects are discussed briefly in the following paragraphs.

NONSTRUCTURAL ALTERNATIVES

NO ACTION--MAINTAIN BASE CONDITION (Alterate 1)

Maintaining the base condition would consist of taking no additional nonstructural or structural action to alleviate flood problems. The base condition for the Bassett Creek watershed consists of a flood forecasting-flood warning system and reliance on emergency flood protection measures, flood plain regulations as required under Federal and State law and flood insurance available under Federal programs. While all municipalities within the watershed have not as yet adopted flood plain ordinances as required by the 1969 Minnesota Flood Plain Act, nor applied for flood insurance, it is anticipated that all of the municipalities within the watershed will do so in the near future.

In the Bassett Creek watershed, flood forecasting-flood warning consists of reasonably predicting the time and magnitude of a flood permitting the evacuation of flood prone areas or the erection of emergency flood protection works. While major regional spring floods caused by snowmelt can be predicted with some reliability, the more localized summer floods due to intense rainstorms cannot. A flood forecasting-flood warning system is presently available for the Upper Mississippi River Basin through the National Weather Service. In addition, the National Weather Service provides a Flash Flood Watch and Warning service through its Minneapolis office. However, forecasting and warning systems alone do not provide sufficient flood protection in the Bassett Creek watershed

because of the short duration of summer rainfall events which produce critical flood levels. As a result of high intensity summer rainfall in the Bassett Creek watershed, flood peaks can be expected to occur in portions of the watershed as early as one hour after rainfall begins and even several hours warning would not provide the time required for the implementation of emergency protection measures. A more detailed discussion of available flood warning-flood forecasting services is included in Section I of this appendix.

Chapter 590 of the Minnesota State Statutes requires counties and cities to enact, administer and enforce local flood plain zoning ordinances. All flood zoning ordinances or flood plain regulations must meet the flood plain management criteria established by the Minnesota Department of Natural Resources. Flood plain regulation prevents or reduces flood damage primarily through the regulation of new development in the flood plain areas. These ordinances do not preclude flood plain development, but rather guide the type and extent of future development permitted in the flood plain consistent with the flood potential.

The flood plain zoning ordinances for the municipalities in the Bassett Creek watershed are in various phases of adoption. All communities in the watershed, except Crystal and Plymouth, have adopted flood plain zoning ordinances approved by the Minnesota Department of Natural Resources. The flood plain zoning ordinances for the Cities of Plymouth and Crystal have been approved by the Minnesota Department of Natural Resources and are in the process of being adopted.

With flood plain regulations in effect in the Bassett Creek watershed, the future development of vacant flood plain area will be discouraged unless development can be protected from flood damage and flood plain

regulations will tend to preserve flood plain areas as open space. Thus, in those reaches of Bassett Creek and its tributaries in which there is no existing development within the 100-year flood plain, flood plain regulations will be effective in preventing or reducing future flood damages. A more detailed discussion of flood plain regulations is included in Section I of this appendix.

Federally subsidized flood insurance is available in the cities of Crystal, Golden Valley, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale and St. Louis Park. Flood insurance is currently not available in the City of Medicine Lake, and the City is not presently required by federal or state laws to enroll in the program. Flood insurance does not prevent or reduce flood damages, but assists only by reimbursing participating property owners for losses sustained from flooding to existing development. Flood insurance does, however, afford the individual affected some economic protection from flood loss by spreading the total economic loss from flooding over a larger portion of the population.

The 1973 Flood Disaster Protection Act requires that developments in identified flood hazard areas in communities participating in the National Flood Insurance Program must be covered by flood insurance after 2 March 1974 to be eligible for any form of mortgage loan from a federally insured or subsidized bank or savings and loan association or from any Federal agency. The Act also requires that after 1 July 1975, or one year after a community has been officially designated as flood prone, whichever is later, no such loans may be approved unless the community is participating in the flood insurance program. This Federal program is authorized by the National Flood Insurance Act of 1968 and makes available under Federal auspices specified amounts of flood insurance previously unavailable from private insurers. The Act requires that the state and local governments adopt and enforce land use control measures that will guide land development in flood prone areas to avoid and reduce future flood damages. Under the program, flood insurance with subsidized premium rates is available to structures in amounts of up to $35,000 for single family dwellings and up to $100,000 for multi-family and nonresidential properties. Insurance on

contents is available to a maximum of $10,000 per unit for residences and $100,000 for nonresidential units. After flood insurance rate studies have been completed in each municipality, coverage up to double these amounts will be available at actuarial rates. A flood insurance rate study for the City of St. Louis Park is in the final stages of completion, and the municipalities of Plymouth, Minneapolis, Robbinsdale and Crystal are scheduled for flood insurance rate studies in the near future.

Maintaining the base conditon or recommending no action be taken to alleviate flood problems would not burden the local interests and the Federal government with the additional financial costs associated with other alternatives. However, average annual flood damages of approximately $767,900 would remain as a severe social and economic burden.

As urbanization of the watershed continues, increased normal flows and flood flows will increase the potential for erosion of the stream banks and sedimentation of the stream bed. The existing threat to public health as a result of damage to water supply distribution systems and wastewater collection facilities would continue. Thus, with the existing base conditions, flood prone development would remain and recurring flood hazards would continue to cause economic losses and threaten the health, safety and social well-being of the people. In addition, the large commercial and industrial area in Minneapolis which is located in the proximity of the entrance to the existing 1.5 mile conduit would continue to be subject to possible catastrophic flooding in the event of a failure or any section of the existing conduit during a large flood or the accumulation of debris which would reduce the discharge capacity of the conduit. If debris accumulation or failure of any section of the existing conduit resulted in a 50% reduction in the discharge capacity during a 100-year flood event, the flood level would be increased by approximately 6 feet and more than 250 acres of developed area would be inundated. In addition to public properties and utilities, more than 450 residential dwellings and more than 80 industries would be flooded. The resulting flood damages would be expected to be in excess of $8 million.

PERMANENT FLOOD PLAIN EVACUATION (Alternate 2)

Permanent evacuation of all damagable flood prone structures from the developed flood plain areas in the Bassett Creek watershed would involve acquisition of lands by purchase, removal and relocation of improvements, evacuation and resettlement of the population, and management and permanent conversion of the lands to uses less susceptible to flood damage. Approximately 222 homes and 18 businesses are currently located within the 100-year flood plain in the Bassett Creek watershed. All of these homes and about 950 persons living in them would have to be relocated. Most of the industries and businesses in the flood plain area cannot be practically or economically moved because of their large size. Estimated tangible first costs for evacuating existing flood prone structures would be approximately $47,856,000 with an average annual benefit of $674,100. The benefit-cost ratio of this plan is 0.23, making the plan economically infeasible.

The extensive adverse social impacts resulting from permanent evacuation of the flood plain would include, disruption of existing physical, social and cultural relationships, increased costs to displaced persons and businesses in seeking alternative locations, increased costs of new financing, the added burden of moving costs, and possible higher operating costs (rent and taxes) at a new location. Personal inconveniences would be considerable, but would be offset somewhat by elimination of the inconvenience resulting from periodic flooding. Evacuation would be unacceptable to many residents with strong ties to their present homes and community. Individuals with investments in local businesses and real estate which might suffer from a relocation would also oppose evacuation.

Ecologically, this alternative is acceptable as the biological systems in the flood plain would probably become more productive and/or diverse. Debris from evacuation could leave a long-term scar on the flood plain, however, much of the material would be recycled or disposed

properly. Movement out of the flood plain would result in improvement of the natural wildlife habitat in some evacuated areas. Relocation of existing families and businesses would also require that the relocation site be subjected to disturbances, clearing of vegetation and permanent disruption of existing ecological relationships.

Although total flood plain evacuation would result in severe adverse social impacts and is economically unsound, small areas of the flood plain can be evacuated without severe adverse effects. These areas include small areas or individual homes or businesses which must be removed to construct flood control works or which cannot be economically protected by other measures. Overall, total permanent evacuation of the 100-year flood plain in the Bassett Creek watershed is one alternative which would permanently reduce flood damage. With permanent evacuation of the 100-year flood plain, unevacuated development in Minneapolis, which is located in the proximity of the entrance to the existing 1.5 mile conduit, would continue to be subject to possible catastrophic flooding in the event of a failure of any section of the existing conduit during a large flood or the accumulation of debris which would reduce the discharge capacity of the conduit.

FLOOD PROOFING AND PARTIAL EVACUATION (Alternate 3)

Flood proofing is a combination of structural changes and adjustments to properties subject to flooding primarily for reduction or elimination of flood damages. Although it is most simply and economically applied to new construction, flood proofing is also applicable to some existing facilities. Individual dwelling units could be flood proofed by installing drain fields, permanently closing low openings, installing check valves and filling around former walk-out basements. Care would have to be taken to assure that residences and businesses to be flood proofed would not become isolated during major floods. This alternative would provide for the flood proofing of all suitable structures within

the 100-year flood plain and evacuating all others. The depth of flooding was used to determine whether a structure could be flood proofed or would have to be evacuated. All buildings which have less than two feet of first floor flooding from the 100-year flood would be flood proofed if access to them could be provided. All other flood prone structures would be evacuated. Using these criteria, 222 homes and 18 businesses would be either flood proofed or evacuated. The estimated first cost for flood proofing and partial evacuation would exceed $26,346,000. The benefit-cost ratio of this plan is 0.41, making the plan economically infeasible.

This alternative could permanently control flood damage as long as flood plain regulations were enforced for the lands evacuated. With flood proofing - partial evacuation the development in Minneapolis, which is in the proximity of the entrance to the existing 1.5 mile conduit, would continue to be subject to possible catastrophic flooding in the event of a failure of any section of the existing conduit during a large flood or the accumulation of debris which would reduce the discharge capacity of the conduit.

STRUCTURAL ALTERNATIVES

Structural measures applicable to flood damage reduction in the Bassett Creek watershed involve combinations of three principal alternative flood control features because of the urban nature of the watershed and development patterns along the creek. These three main categories are channel modification, flood storage and diversion. In those areas where there is little or no existing development in the flood plain, maintaining the base condition is the most cost effective method of providing protection against future flood damage. These areas would include Plymouth Creek upstream of Medicine Lake, the North Branch of Bassett Creek upstream of Louisiana Avenue North and the Sweeney Lake Branch of Bassett Creek.

Combinations of the three main categories of structural flood control measures are applicable to the Bassett Creek watershed, however, in the reach from the Mississippi River to Irving Avenue, other strucutral

alternatives were investigated regarding the outlet for Bassett Creek. The outlet alternatives fall into three basic categories: repair of the existing conduit, a new conduit and an open channel. Several routes for a new outlet conduit for Bassett Creek were reviewed, some of which would cooperatively utilize drainage facilities with those proposed by the Minnesota Highway Department to provide drainage for the proposed Interstate 94 and Third Avenue highway distributor. In accordance with Minnesota Highway Department policy, the cost of these combined drainage facilities would be shared with the Highway Department based on peak flow contributions. To some degree, the selection and coordination of one of these alternative routes depends on the alternative selected by the Minnesota Highway Department to provide drainage from the proposed Interstate 94 and Third Avenue highway distributor and their proposed construction schedules. The Minnesota Highway Department has recommended that a tunnel beginning at the intersection of 12th Avenue and 4th Street, following an alignment along 2nd Street and outletting in the middle pool below St. Anthony Falls be constructed to provide drainage for the proposed Interstate Highway 94 and that Bassett Creek be incorporated into the drainage system for the Third Avenue distributor entering the tunnel at Third Avenue North[1]. The recommended cooperative alternative has the lowest total cost and would result in fewer complications with construction schedules for the cooperative and non-cooperative portions of the tunnels. At the present time, the Third Avenue highway distributor is scheduled for construction in the spring of 1977, while the construction schedule for Interstate 94 has been set for the spring or summer of 1977.

Another alternative for providing a new conduit in the outlet reach of Bassett Creek would be to construct a conduit entirely and at the complete expense of the flood control project. This alternative would not utilize combined drainage facilities and, therefore, the entire burden of the construction cost would be placed on the flood control project.

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[1] Preliminary Design Report, Drainage Study on Interstate 94 in Minneapolis, Minnesota Highway Department, September 1975.

Several open channel alternatives were identified for the reach of Bassett Creek from the Mississippi River to Irving Avenue. The most acceptable open channel alternative would provide a broad open space corridor from approximately the inlet of the existing conduit to the Mississippi River through which Bassett Creek would flow.

In order to facilitate the discussion of the flood control alternatives for the watershed as a whole, combinations of the three basic flood control measures of flood storage, channel modification and diversion are discussed for each of the outlet alternatives for Bassett Creek in the reach from the Mississippi River to Irving Avenue. Following that discussion, the outlet alternatives for the reach from the Mississippi River to Irving Avenue are discussed in combination with flood storage and nonstructural alternatives.

FLOOD STORAGE AND CHANNEL MODIFICATION
WITH REPAIR OF EXISTING CONDUIT (Alternate 4-A)

This alternate would generally consist of modifying the channel, thus improving its discharge capacity, within limits imposed by development along the creek and repairing the existing conduit. The channel would be enlarged and straightened to the extent feasible and necessary with a minimum encroachment on private property. Generally, the existing temporary flood water storage provided by existing restrictive channel crossings upstream of the reaches requiring channel modification would be sufficient to lower the discharge to a level which could be conveyed by the modified channels. Features of this plan are shown in Plate D-1.

With this alternate, the existing conduit (Mississippi River to Mile 1.52) would be repaired to extend its useful life. The repairs would generally consist of relining the existing tunnel, replacing portions of the existing tunnel roof and walls and slightly increasing the discharge capacity of the tunnel at certain locations.

In addition, in order to provide 100-year flood protection, an inundation storage area would be required upstream of the existing conduit

inlet (Mile 1.52 to Mile 1.85) because adequate discharge capacity to pass the entire flood flow could not be provided. Flood walls would be required along the periphery of the inundation area to protect the surrounding development. Interior drainage facilities would be included to prevent flooding from occurring behind the flood walls. The proposed 100-year flood level in this inundation storage area would be approximately 1 foot higher than the existing 100-year flood level at the conduit inlet.

Between the conduit inlet and Penn Avenue, this alternative would generally consist of some clearing and snagging to improve the hydraulic efficiency of the channel. The old Penn Avenue box culvert (Mile 2.35), which is no longer used for vehicular traffic, would be removed and the immediate area would be landscaped to improve the hydraulic efficiency of the channel in this location. Immediately downstream from Glenwood Avenue (Mile 2.61 to Mile 2.81), flood walls would be constructed on the left bank of the channel to protect the businesses located there and the channel in this location would be enlarged, which would require construction of retaining walls on the right bank of the channel. The existing low head rock dam would be replaced.

Between Glenwood Avenue and Bassett Creek Drive (Mile 2.81 to Mile 5.14), the existing flood water storage on Theodore Wirth Park and Rice Lake would be utilized and the existing flood levels would not be increased. Portions of Dresden Lane (Mile 4.91) and Bassett Creek Drive (Mile 5.14) would be raised to prevent inundation during flood periods.

From Bassett Creek Drive to Highway 100 (Mile 5.14 to Mile 6.55), the channel would be widened and straightened and each of the channel crossings would be enlarged. The channel crossing at Bassett Creek Drive just upstream of Rice Lake would be replaced by a larger culvert, the channel crossings at Noble Avenue (Mile 5.53) and Regent Avenue (Mile 5.83) would be replaced by bridges and the Minnaqua Avenue bridge (Mile 5.94) would be removed.

Upstream of Highway 100, Bassett Creek Park will be utilized for temporary flood water storage in its existing state and at its existing flood level. A portion of 29th Avenue, immediately downstream of Bassett Creek Park crossing the North Branch of Bassett Creek (Mile 0.04) would

be raised slightly to prevent inundation during flood periods. Along the main stem, the channel of the creek would be enlarged and improved and several crossings between Westbrook Road and Hampshire Avenue (Mile 7.01 to Mile 8.22) would be improved. Temporary flood water storage would be provided on Brookview Community Golf Course (Mile 9.15 to Mile 10.70) to reduce downstream discharges to the capacity of the improved channel. The proposed 100-year flood level on Brookview Community Golf Course would be approximately one foot above the existing 100-year flood level. In the reach immediately downstream from Medicine Lake (Mile 11.97 to Mile 12.11), the channel would be modified slightly, which along with repair of the outlet structure would improve the hydraulic efficiency of the Medicine Lake outlet and prevent damage to dwellings around Medicine Lake. The proposed 100-year flood level on Medicine Lake would be approximately 0.5 foot below the existing 100-year flood level.

Along the North Branch of Bassett Creek, the existing channel crossings would be enlarged sufficiently at 32nd Avenue (Mile 0.49), Adair Avenue and Brunswick Avenue (Mile 0.57) to lower the flood level upstream of 32nd Avenue and prevent flood damages to dwellings in the area. Portions of Adair, Brunswick and 32nd Avenues would be raised slightly to prevent inundation during flood periods. Some temporary flood storage would be retained upstream of 32nd Avenue North. The channel crossing at 34th Avenue North (Mile 0.80) would be replaced by a larger culvert. The existing flood storage on each side of Douglas Drive (Mile 0.99) would be utilized at its existing 100-year flood level, and Douglas Drive would be raised slightly to prevent inundation during flood periods.

The channel crossings at Florida (Mile 1.12), Georgia (Mile 1.18) and Hampshire Avenues (Mile 1.29) would be replaced by large culverts. A new storm sewer would collect the local drainage between Hampshire and Louisiana Avenues (Mile 1.52) and route it downstream of Hampshire, thus reducing the flood level in the area between Hampshire and Louisiana Avenues North.

The first cost of this plan would be $12,218,000 and the benefit-cost ratio would be 0.89. With this plan, residual average annual flood damages of $93,800 would remain. These damages are due to floods of greater frequency than the 100-year frequency flood, and for

damages incurred by the flooding of Theodore Wirth Golf Course, the increased flood storage on Brookview Community Golf Course, and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 4-B)

This plan consists of the channel modification alternative (Alternate 4-A) for the upper Bassett Creek watershed except for the reach from the Mississippi River to Irving Avenue (Mile 1.85). In this reach, a new conduit would be constructed in the right-of-way of city streets where possible or through industrial areas. The route of this outlet alternative is shown in Plate D-2. This new conduit would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and which is in need of extensive repair to extend its useful life.

The proposed new conduit would follow 2nd Avenue North to the right-of-way of the proposed Interstate 94. From the right-of-way of the proposed Interstate 94 to 5th Street North and 5th Avenue North, the proposed route would meander through industrial areas to avoid disruption of existing development. From 5th Street North and 5th Avenue North, the route of the proposed conduit would follow the right-of-way of 5th Avenue North to 2nd Street North, the right-of-way of 2nd Avenue North to 4th Avenue North and follow the right-of-way of 4th Avenue North to the Mississippi River. This alternative for a new conduit requires approximately 50 acre-feet of temporary flood water storage in the area immediately upstream of the proposed conduit inlet (Mile 1.52 to Mile 1.93), which substantially reduces the required discharge capacity of the conduit. This flood storage area would be excavated to provide flood water retention with or without permanent storage and the proposed 100-year flood level to the storage area would be approximately 4 feet below the existing 100-year flood level in the area. The construction of this storage area significantly reduces the cost of the new conduit between the inlet and the Mississippi River.

The first cost of this plan would be $15,425,000 and the benefit-cost ratio would be 0.71. With this plan, residual average annual flood damages of $93,800 would remain. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by the flooding of the Theodore Wirth Golf Course, the Brookview Community Golf Course and the residual transportation on the Sweeney Lake Branch.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 4-C)

This plan consists of the channel modification alternative (Alternate 4-A) for the upper Bassett Creek watershed and the construction of a new conduit for the reach from the Mississippi River to Irving Avenue (Mile 1.85).

The new conduit would be constructed in the right-of-way of the proposed Third Avenue highway distributor and would connect to a proposed highway drainage tunnel at Third Avenue and Washington Avenue. The route of this outlet alternative is shown on Plate D-2. The proposed highway drainage tunnel would outfall into the Mississippi River below St. Anthony Falls. This new conduit would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and is in need of extensive repair to extend its useful life. This alternative for a new conduit requires a temporary flood storage area of approximately 90 acre-feet immediately upstream of the proposed conduit inlet (Mile 1.52 to Mile 1.93), which substantially reduces the required discharge capacity of the conduit. This flood storage area would be constructed as an inundation area or as a pond and the proposed 100-year flood level would be approximately 4 feet below the existing 100-year flood level in this area. The construction of this temporary flood storage area significantly reduces the total cost of the new conduit between the inlet and the Mississippi River.

The first cost of this plan would be $10,898,000 and the benefit-cost ratio would be 1.00. The residual average annual damages remaining with this plan would be $93,800. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by the flooding of the Theodore Wirth Golf Course, the temporary storage of flood waters on the Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 4-D)

This plan consists of the flood storage and channel modification alternative (Alternate 4-A) for the Bassett Creek watershed, except for the reach from the Mississippi River to Irving Avenue (Mile 1.85). In this reach, a new conduit would be constructed in the right-of-way of the proposed Interstate 94 and would connect to a proposed highway drainage tunnel at 12th Avenue North and Washington Avenue. The route of this outlet alternative is shown on Plate D-2. The proposed highway drainage tunnel would outfall into the Mississippi River below St. Anthony Falls. This new conduit would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and which is in need of extensive repair to extend its useful life. This alternative for a new conduit requires approximately 90 acre-feet of temporary flood water storage in the area immediately upstream of the proposed conduit inlet (Mile 1.42 to Mile 1.93), which substantially reduces the required discharge capacity of the conduit. This flood storage area would be excavated to provide flood water retention with or without permanent storage and the proposed 100-year flood level storage in the area would be approximately 4 feet below the existing 100-year flood level in this area. The construction of this temporary flood storage area significantly reduces the total cost of the new conduit between the inlet and the Mississippi River.

The first cost of this plan would be $11,938,000 and the benefit-cost ratio would be 0.91. The residual average annual damages remaining in this plan would be $93,800. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by the flooding of the Theodore Wirth Golf Course, the temporary storage of flood waters in Brookview Community Golf Course, and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH AN OPEN SPACE - OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 4-E)

This plan would consist of the flood storage and channel modification alternative (Alternate 4-A) for the Bassett Creek watershed except for the reach from the Mississippi River to Irving Avenue (Mile 1.85). In this reach, rather than repair the existing conduit or construct a new conduit, an open channel with substantial open space on either side of the channel would provide the new outlet for Bassett Creek. The route of this outlet alternative is shown on Plate D-2. This proposed open channel alternative would begin near the inlet of the existing conduit and cross Glenwood Avenue between Aldrich and Bryant Avenues North. Between Third Avenue and 4th Avenue North, the route would turn easterly so that the open channel would cross 4th Avenue North between Aldrich and the proposed frontage road to Interstate 94. The open channel corridor would then proceed to follow the right-of-way of Interstate 94 to approximately Olson Memorial Highway. The proposed open channel corridor would cross Interstate 94 and remain between 7th and 8th Avenues North to the existing outlet of Bassett Creek at the Mississippi River.

This proposed open channel would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and which is in need of extensive repair to extend its useful life. This open channel alternative requires approximately 20 acre-feet of temporary flood storage in the area immediately upstream from the inlet

of the new channel. This flood storage area would be excavated to provide the required volume and would be constructed as an inundation area or as a pond. The proposed 100-year flood level in this storage would be four feet below the existing 100-year flood level in the area. The construction of the flood storage area reduces the peak discharge capacity required in the proposed open channel.

The City of Minneapolis has initiated a study to review possible redevelopment alternatives in this portion of north Minneapolis. Although the study has not been completed, it is anticipated that if the open space and open channel corridor were included as a part of the redevelopment alternatives for this area, substantial recreational and land enhancement benefits could be realized by construction of this plan. However, the magnitude of the recreational benefits and land enhancement benefits cannot be evaluated until more information regarding the proposed redevelopment of the area including changes in land use and population densities are known and, therefore, these potential benefits are not reflected in the benefit to cost ratio. .

The first cost of this plan would be $62,145,000 and the benefit-cost ratio would be 0.18 with only flood control benefits assuming no increased recreational benefits or land enhancement benefits due to future redevelopment of the area. With this plan, residual average annual flood damages of $93,800 would remain. These damages would be the result of storms of greater frequency than the 100-year storm and would include damages incurred by flood water inundation of Theodore Wirth Golf Course, the temporary storage of flood waters in the Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND DIVERSION WITH REPAIR OF EXISTING CONDUIT (Alternate 5-A)

This plan consists of a flood storage and diversion alternative for the upper Bassett Creek watershed and repair of the existing conduit

(Alternate 4-A) for the reach from the Mississippi River to Irving Avenue (Mile 1.85). This plan would utilize potential flood water storage areas in the watershed or diversion in order to lower discharges in the channel and minimize the need for channel modifications. The features of the alternative are shown on Plate D-3.

The major temporary flood water storage areas along the main stem would include: Theodore Wirth Golf Course, Rice Lake, Bassett Creek Park, the Golden Valley Golf Course and Brookview Community Golf Course. A control structure would be installed upstream of Highway 55 (Mile 3.15) which would increase the 100-year flood level on Theodore Wirth Golf Course to approximately two feet above the existing 100-year flood level. This proposed restriction would not change the normal level of the creek through the golf course. The existing restriction at Dresden Lane (Mile 4.91) would be retained to provide temporary flood water storage in the Rice Lake area at approximately its existing 100-year flood level. The proposed 100-year flood level on Bassett Creek Park would be approximately three feet above the existing 100-year flood level and would require a new outlet structure immediately upstream of Highway 100 (Mile 6.46). This outlet structure would consist of a low level conduit to pass normal flow and a weir to pass the flood flow discharges. A restriction would be installed in the channel on the property of Golden Valley Golf Club (Mile 8.32) which would provide approximately 27 acre-feet of temporary flood water storage and the proposed 100-year flood level would be about 0.5 feet lower than the existing 100-year flood level in this area. The proposed 100-year flood level of the Brookview Community Golf Course would be approximately one foot higher than the existing 100-year flood level due to the new channel restriction just upstream of Winnetka Avenue (Mile 9.15). The proposed restriction would consist of a low level conduit to pass normal flow and a weir to pass the flood flow discharges.

In the reach of the main stem immediately downstream of the Medicine Lake outlet (Mile 11.97 to 12.11), a short reach of the channel would require

modification, which along with repair of the Medicine Lake outlet, would improve the hydraulic efficiency of the outlet and prevent flood damage from occurring around Medicine Lake. The proposed 100-year flood level on Medicine Lake would be approximately 0.5 foot below the existing 100-year flood level.

On the main stem, this plan would provide for the diversion of flood flows from Theodore Wirth Park just upstream of Glenwood Avenue (Mile 2.81) to approximately Penn Avenue (Mile 2.35) to protect the industries located in the area, and to minimize the need for channel improvements in this area. The old Penn Avenue box culvert, which is not longer used for vehicular traffic, would be removed and the immediate area would be landscaped to improve the hydraulic efficiency of the channel at this location. A diversion from Scott Avenue and Culver Road (Mile 6.34) to Rice Lake would intercept a large tributary area to the north of the creek and divert the flood flows to Rice Lake. This diversion would protect the homes between Noble Avenue (Mile 5.53) and Highway 100 (Mile 6.44) and eliminate the channel modifications between Bassett Creek Drive (Mile 5.14) and Highway 100. On the North Branch, a diversion from 36th Avenue North and Jersey Avenue (Mile 1.40) to a flood water storage site at 32nd Avenue and Florida Avenue would be provided. This diversion would provide protection for the homes between Hampshire Avenue and Louisiana Avenue (Mile 1.20 to Mile 1.52) and minimize the required channel modifications in this reach.

The first cost of this plan would be $14,187,000 and the benefit-cost ratio would be 0.76. The residual average annual damages remaining with this plan would be $97,600. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by increased flood storage on Theodore Wirth Golf Course, Golden Valley Golf Course and Brookview Community Golf Course and the residual transporation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT
IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 5-B)

This plan consists of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-B) for the reach from the Mississippi River to Irving Avenue (Mile 1.85).

The first cost of this plan would be $17,394,000 and the benefit-cost ratio would be 0.63. With this plan, residual average annual flood damages of $97,600 would remain. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by the temporary storage of flood water on Theodore Wirth Golf Course, Golden Valley Golf Course and Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT
IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY
AND DEEP TUNNEL (Alternate 5-C)

This plan consists of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-C) for the reach from the Mississippi River to Irving Avenue.

The first cost of this plan would be $12,868,000 and the benefit-cost ratio would be 0.84. The residual average annual damages remaining with this plan would be $97,600. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by temporary flood storage on Theodore Wirth Golf Course, Golden Valley Golf Course and on Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT -
INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 5-D)

This plan consists of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-D) for the reach from the Mississippi River to Irving Avenue (Mile 1.85).

The first cost of this plan would be $13,907,000 and the benefit-cost ratio would be 0.78. The residual average annual damages remaining with this plan would be $97,600. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by temporary storage of flood waters in the Theodore Wirth Golf Course, Golden Valley Golf Course and the Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND DIVERSION WITH AN OPEN SPACE-
OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER
(Alternate 5-E)

This plan would consist of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and an open space-open channel corridor (Alternate 4-E) for the reach from the Mississippi River to Irving Avenue (Mile 1.85).

The first cost of this plan would be $64,114,000 and the benefit-cost ratio would be 0.17. With this plan, residual average annual flood damages of $97,600 would remain. These damages would result from storms of greater frequency than the 100-year frequency storm and would include damages incurred by the temporary storage of flood waters on the Golden Valley Golf Course and the Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

COMBINATION OF NONSTRUCTURAL AND STRUCTURAL ALTERNATIVES

FLOOD STORAGE AND FLOOD PROOFING WITH REPAIR OF EXISTING CONDUIT (Alternate 6-A)

This plan consists of flood storage in combination with flood proofing for the Bassett Creek watershed and repair of the existing conduit (Alternate 4-A) in the reach from the Mississippi River to Irving Avenue (Mile 1.85). This plan would utilize potential flood water storage areas in the watershed in order to reduce flood discharges in the channel. Residences which cannot be protected by flood storage alone would be flood proofed to minimize the need for channel modifications and diversions. The features of this plan are shown on Plate D-4.

The major temporary flood water storage areas along the main stem would include: Theodore Wirth Golf Course, Rice Lake, Bassett Creek Park, the Golden Valley Golf Course and Brookview Community Golf Course. The existing channel crossing at Highway 55 (Mile 3.15) would be modified, which would increase the 100-year flood level on Theodore Wirth Golf Course approximately two feet above the existing 100-year flood level. This proposed restriction would not change the normal level of the creek through the golf course. The existing restriction at Dresden Lane (Mile 4.91) would be retained to provide temporary flood water storage in the Rice Lake area at approximately its existing 100-year flood level. The proposed 100-year flood level on Bassett Creek Park would be approximately three feet above the existing 100-year flood level and would require a new outlet structure immediately upstream of Highway 100 (Mile 6.46). This outlet structure would consist of a low level conduit to pass normal flows and an overflow weir to pass extreme flood flow discharges. A control structure would be installed in the channel on the property of Golden Valley Golf Club (Mile 8.32) to provide temporary flood water storage and the proposed 100-year flood level would be about 0.5 feet lower than the existing 100-year flood level in this area. The proposed 100-year flood level of the Brookview Community Golf Course would be approximately one foot

higher than the existing 100-year flood level due to a new control structure just upstream of Winnetka Avenue (Mile 9.15). The proposed restriction would consist of a low level conduit to pass normal flow and an overflow weir to pass the flood flow discharges.

Between the conduit entrance and Penn Avenue (Mile 1.52 to Mile 2.35), this alternative would involve clearing and snagging to improve the hydraulic efficiency. The old Penn Avenue box culvert, which is no longer used for vehicular traffic, would be removed and the immediate area would be landscaped to improve the hydraulic efficiency of the channel at this location. Immediately downstream of Glenwood Avenue (Mile 2.61 to Mile 2.81) floodwalls and retaining walls would be constructed on either side of the channel to protect the businesses located there and the channel would be enlarged. The height of these walls would be about one foot higher than the existing retaining walls in this reach.

Between Golden Valley Road and Dresden Lane (Mile 4.51 to Mile 4.91), a total of 3 homes would be flood proofed to prevent flood damage at the reduced 100-year flood level. Portions of Dresden Lane (Mile 4.91) and Bassett Creek Drive (Mile 5.14), at the south end of Rice Lake would be raised to prevent inundation during flood periods. The Noble Avenue (Mile 5.53) and Regent Avenue (Mile 5.83) channel crossings would be replaced by larger culverts and the bridge at Minnaqua Avenue (Mile 5.94) would be removed. Between Regent Avenue and Highway 100 (Mile 5.83 to Mile 6.44), 6 homes would be flood proofed to prevent flood damage at the reduced 100-year flood level.

In this reach of the main stem immediately downstream of the Medicine Lake outlet (Mile 11.97 to Mile 12.11), a short reach of the channel would require modification, which along with repair of the Medicine Lake outlet would improve the hydraulic efficiency of the outlet and prevent flood damage from occurring around Medicine Lake. The proposed 100-year flood level on Medicine Lake would be approximately 0.5 foot below the existing 100-year flood level.

Along the North Branch of Bassett Creek, the existing channel crossing would be enlarged sufficiently at 32nd Avenue (Mile 0.49), Adair Avenue

and Brunswick Avenue (Mile 0.57) to lower the flood level upstream of 32nd Avenue and prevent flood damages to dwellings in the area. Portions of Adair, Brunswick and 32nd Avenues would be raised slightly to prevent inundation during flood periods. Some temporary flood storage would be retained upstream of 32nd Avenue North. The channel crossing at 34th Avenue (Mile 0.80) would be replaced by a larger culvert. The existing flood storage area on each side of Douglas Drive (Mile 0.99) would be used at its existing level and Douglas Drive would be raised slightly to prevent inundation during flood periods. Midway between Douglas Drive and Florida Avenue (Mile 1.05), a restrictive channel crossing would be constructed consisting of new embankment with an outlet culvert for normal flows and an overflow weir for flood flows. The channel between the proposed embankment and Louisiana Avenue (Mile 1.05 to Mile 1.52) would be modified and enlarged, the channel crossings at Florida Avenue (Mile 1.12) and Hampshire Avenue (Mile 1.29) would be replaced by large culverts and Georgia Avenue (Mile 1.18) would be removed, thus reducing the 100-year flood level in the area between Hampshire and Louisiana Avenues. This alternative would require the removal of three residential dwellings and relocation of the affected residents.

The first cost of this plan would be $11,031,000 and the benefit-cost ratio would be 0.98. With this plan, residual average annual flood damages of $98,600 would remain. These damages are due to floods of greater frequency than the 100-year frequency flood and include the damages incurred by temporarily storing flood waters on the Theodore Wirth Golf Course, the Golden Valley Golf Course and the Brookview Community Golf Course and the residual transportation damage on the Sweeney Lake Branch.

FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 6-B)

This plan generally consists of the flood storage and flood proofing alternative (Alternate 6-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-B) in the reach from the Mississippi River to Irving Avenue (Mile 1.85).

The first cost of this plan would be $13,968,000 and the benefit-cost ratio would be 0.78. With this plan, residual average annual flood damages of $98,600 would remain. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by flood water inundation of Theodore Wirth Golf Course, Golden Valley Golf Course and Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND FLOOD PROOFING WITH NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-C)

This plan generally consists of the flood storage and flood proofing (Alternate 6-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-C) in the reach of the Mississippi River to Irving Avenue (Mile 1.85).

The first cost of this plan would be $9,439,000 and the benefit-cost ratio would be 1.14. The residual average annual damages remaining with this plan would be $98,600. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by flood water inundation of Theodore Wirth Golf Course, Golden Valley Golf Course and Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-D)

This plan generally consists of the flood storage and flood proofing alternative (Alternate 6-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-D) for the reach from the Mississippi River to Irving Avenue (Mile 1.85)

The first cost of this plan would be $10,751,000 and the benefit-cost ratio would be 1.01. The residual average annual damages remaining with this plan would be $98,600. These damages would be the result of storms

of greater frequency than the 100-year frequency storm and would include damages incurred by flood water inundation of Theodore Wirth Golf Course, Golden Valley Golf Course, and the Brookview Community Golf Courses and the residual transportation damages on the Sweeney Lake Branch.

FLOOD STORAGE AND FLOOD PROOFING WITH AN OPEN SPACE-
OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 6-E)

This plan generally consists of the flood proofing and partial evacuation alternative (Alternate 6-A) in the upper Bassett Creek watershed and an open space-open channel corridor (Alternate 4-E) for the reach from the Mississippi River to Irving Avenue (Mile 1.85).

The first cost of this plan would be $60,958,000 and the benefit-cost ratio would be 0.18. The residual average annual damages remaining with this plan would be $98,600. These damages would be the result of storms of greater frequency than the 100-year frequency storm and would include damages incurred by flood water inundation of Theodore Wirth Golf Course, Golden Valley Golf Course and Brookview Community Golf Course and the residual transportation damages on the Sweeney Lake Branch.

OTHER ALTERNATIVES CONSIDERED

Several additional plans were considered for various reaches of the creek, but were rejected because they did not provide 100-year flood protection or because they were economically, socially, or environmentally undesirable. Enlargement of the channel throughout the watershed without reliance on existing flood storage sites would require the replacement of most of the existing channel crossings and extensive relocation of existing development to construct the enlarged channel. Flood barriers were also considered as a flood control measure, however, they would be aesthetically displeasing in residential areas and would require extensive relocation of existing development to construct interior drainage systems.

In the reach from the Mississippi River to Theodore Wirth Park, several alternates were considered including: a deep tunnel from the existing conduit entrance to the river, a diversion to the drainage

facilities for Interstate Highway 35W, a diversion to Birch Pond and then to Brownie Lake and a conduit under Plymouth Avenue from Theodore Wirth Park to the Mississippi River. Several alternative routes for an open channel with varying cross-sections were also reviewed.

In the reach from Theodore Wirth Park to Medicine Lake, several diversion plans from various points on the creek to Sweeney Lake were considered. Upstream of Medicine Lake, a system of temporary storage ponds was reviewed. However, the problems associated with providing adequate upstream storage for the length of time required to lower the flood level of Medicine Lake make this alternative highly unfavorable economically in comparison to improvement in the hydraulic efficiency of the Medicine Lake outlet. Improving the hydraulic efficiency of the Medicine Lake outlet and decreasing the 100-year flood level approximately 0.5 foot on Medicine Lake will have no adverse effects on downstream areas and will provide flood protection for the dwellings around Medicine Lake. Along the Sweeney Lake Branch, several variations of the existing channel were considered and along the North Branch, several alternate methods of diverting flood flows were considered.

The alternative of increasing the temporary flood storage in Theodore Wirth Park or not increasing the existing flood level and its effect on downstream areas was evaluated extensively. Without increased flood storage in Theodore Wirth Golf Course, the flood walls downstream of Glenwood Avenue (Mile 2.57 to Mile 2.81) must be higher and the size of the cooperative conduit must be increased. With the increased conduit size, the storage area at the conduit entrance can be reduced slightly, however, the cost of alternatives without storage at Theodore Wirth Golf Course would be about $1 million higher than alternatives with storage in the golf course.

The cooperative conduit alternatives with varying amounts of storage volume at the conduit entrance were also reviewed. Without storage at the conduit entrance, the capacity of the cooperative conduit would have to be approximately doubled because inflow from Bassett Creek and inflow from

highway drainage areas will coincide. Alternatives without storage at the conduit entrance would cost approximately $3 million more than alternatives with storage at the conduit entrance. The most econonic alternative requires approximately 90 acre-feet of storage volume at the conduit entrance.

EVALUATION OF ALTERNATIVES

Possible alternative solutions were identified based on the ability of each to satisfy the basic objective of wise water and related land resource management for both short- and long-term needs of the Bassett Creek watershed. The overriding objective guiding further development of the alternatives is the ability to satisfy the need for flood damage reduction or compensation for which the study was authorized. The environmental, economic and social well-being objectives are also taken into consideration for guiding further development of the alternatives where they are consistent with the ability to satisfy the need for flood damage reduction.

All alternatives which offer an acceptable degree of flood damage reduction of compensation for incurred flood damages would enhance the economic welfare of the citizens of the Bassett Creek watershed. The no action--maintain the base condition alternative consisting of flood plain regulation and flood forecasting-flood warning would lessen future flood damages and flood insurance would reimburse through compensation flood damage losses to existing development in the flood plain. The existing flood insurance premiums are heavily subsidized by the Federal Government making this insurance economically attractive to flood plain residents. However, in the future, as flood insurance rate studies are completed in the municipalities within the watershed, the flood insurance premiums for new development will be based on actuarial rates making flood insurance less attractive.

Permanent evacuation of the flood plain would give immediate protection from flood damages and when combined with the base condition, would reduce future flood damages. However, the high economic cost and the social

disruption resulting from this plan make this plan extremely impractical and undesirable in the Bassett Creek watershed. In addition, permanent evacuation of the flood plain is economically infeasible. However, partial evacuation warrants further consideration for small areas or individual homes or businesses which must be removed to construct flood control works or which cannot be economically protected by other measures.

The flood proofing and partial evacuation alternative would tend to enhance the local economy by reducing future flood damages in flood prone areas within the watershed. However, those residents being relocated might disagree with this conclusion. The cost to the local sponsor may not be offset by flood damage reduction with this plan due to the long-term effects of reduced property tax base. Within the large metropolitan area, the primary and secondary local employment benefits resulting from evacuation, reconstruction and flood proofing measures would be slight although some regional benefits would result. The flood proofing and partial evacuation plan would provide a high degree of flood damage reduction, however, some impacts of flooding would remain such as disruption of transportation and potential dangers to health and safety. While this alternative satisfies the specific objective of flood damage reduction, the social disruption due to the partial evacuation, the disruption to transportation, and the potential dangers to health and safety make this plan undesirable and unacceptable for the Bassett Creek watershed. However, in certain reaches of Bassett Creek and its tributaries where existing development is not isolated during major floods and is not subject to excessive inundation, flood proofing and partial evacuation as a supplement to the base condition or in combination with structural alternatives provides a viable flood damage reduction alternative.

The effects of the structural alternatives on the quality and aesthetics of Bassett Creek varies considerably. The flood storage and channel modification alternative would have severe adverse effects on the quality and aesthetics of Bassett Creek. Channel modifications would necessitate the removal of a large number of mature trees and the understory vegetation growing along those reaches of Bassett Creek. While restoration measures

such as landscaping and replanting would minimize the long-term adverse aesthetic effects due to channel modification, the short-term aesthetic effects would have a significant adverse effect on the residential properties abutting the creek through most of the reaches requiring channel modification. In addition, significant short-term effects on the biological systems in the creek bed and overbank areas would occur with the construction of the channel modifications. The biological diversity of these areas would be significantly disturbed or destroyed as a result of the construction of the channel modifications. In the long-term, the biological systems which would be reestablished along the creek would differ significantly from those which currently exist in those areas. The aesthetics of the creek corridor would be significantly changed in the long-term due to the removal of the natural meanders, oxbows and backwater waters which currently exist along the creek. During the construction of the channel modification, the erosion of exposed soils and the subsequent sedimentation would have a severe adverse effect on the water quality and aesthetic value of the creek in the reaches downstream of the channel modifications.

The residents of the watershed have indicated that extensive channel modifications are unacceptable due to the environmental and aesthetic effects. In addition, as shown on Table 1, there are several alternative plans more economically feasible than the flood storage and channel modification alternative.

The flood storage and diversion alternative would significantly reduce the adverse effects on the quality and aesthetics of Bassett Creek when compared to channel modification. The area subjected to the short-term impacts of project construction are significantly smaller for the flood storage and diversion alternative than for the flood storage and channel modification alternative since it would require the disruption of the stream channel and overbank areas only at the locations of the flood storage contol structures and where channel crossings are being replaced. The flood control structures would consist of earth embankments similar to those at many of the street crossings of the channel. These earth embankments would be seeded and planted to provide aesthetically pleasing structures.

TABLE 1 ECONOMIC IMPACTS OF FLOOD DAMAGE REDUCTION ALTERNATIVES FOR THE BISSETT CREEK WATERSHED[1]

	Alternate 1 No Action-Maintain Base Condition	Alternate 2 Permanent Flood Plain Evacuation	Alternate 3 Flood Proofing and Partial Evacuation	Alternate 4-A Flood Storage-Channel Modification Repair Existing Conduit	Alternate 4-B Flood Storage-Channel Modification New Conduit Non-Highway	Alternate 4-C Flood Storage-Channel Modification New Conduit-3rd Avenue	Alternate 4-D Flood Storage-Channel Modification New Conduit-Interstate 94	Alternate 4-E Flood Storage-Channel Modification Open Space-Open Channel Corridor	Alternate 5-A Flood Storage-Diversion Repair Existing Conduit
Total First Cost	0	47,856,000	26,346,000	12,218,000	15,425,000	10,898,000	11,938,000	62,165,000	14,187,000
Federal First Cost	0	38,285,000	21,077,000	8,674,000	11,208,000	8,038,000	8,644,000	9,810,000	11,028,000
Non-Federal First Cost	0	9,571,000	5,269,000	3,544,000	4,217,000	2,860,000	3,294,000	52,335,000	3,159,000
Total Average Annual Cost	?	2,938,800	1,617,900	750,300	947,300	669,300	733,100	3,816,300	871,200
Federal Average Annual Cost	?	2,350,800	1,293,600	532,700	688,400	493,100	530,400	602,800	676,600
Non-Federal Average Annual Cost	?	588,000	324,300	217,600	258,900	176,200	202,700	3,213,500	194,600
Non-Federal Maintenance	0	0	0	13,000	10,000	10,000	10,000	12,000	14,000
Average Annual Benefits	?	683,500	663,800	677,200	677,200	677,200	677,200	677,200	674,800
Net Average Annual Benefits	?	-2,255,300	-954,100	-86,100	-280,100	-2,100	-65,900	-3,151,100	-210,400
Benefit-Cost Ratio	?	0.23	0.41	0.89	0.71	1.00	0.91	0.18	0.76

	Alternate 5-B Flood Storage-Diversion New Conduit Non-Highway	Alternate 5-C Flood Storage-Diversion New Conduit-3rd Avenue	Alternate 5-D Flood Storage-Diversion New Conduit-Interstate 94	Alternate 5-E Flood Storage-Diversion Open Space-Open Channel Corridor	Alternate 6-A Flood Storage-Flood Proofing Repair Existing Conduit	Alternate 6-B Flood Storage Flood Proofing New Conduit Non-Highway	Alternate 6-C Flood Storage-Flood Proofing New Conduit-3rd Avenue	Alternate 6-D Flood Storage-Flood Proofing New Conduit-Interstate 94	Alternate 6-E Flood Storage-Flood Proofing Open Space-Open Channel Corridor
Total First Cost	17,994,000	12,868,000	13,907,000	64,114,000	11,031,000	13,968,000	9,630,000	10,751,000	60,950,000
Federal First Cost	13,562,000	10,393,000	10,998,000	12,164,000	8,087,000	10,330,000	6,723,000	7,977,000	9,143,000
Non-Federal First Cost	3,832,000	2,475,000	2,909,000	51,950,000	3,024,000	3,638,000	2,716,000	2,774,000	51,835,000
Total Average Annual Cost	1,068,200	790,200	854,000	3,937,200	677,400	857,800	579,700	640,200	3,743,000
Federal Average Annual Cost	832,300	637,900	675,400	747,100	492,000	634,500	413,600	489,700	561,400
Non-Federal Average Annual Cost	235,900	152,300	178,600	3,190,100	185,400	223,300	166,100	170,500	3,181,600
Non-Federal Maintenance	11,000	11,000	11,000	13,000	13,000	10,000	10,000	10,000	12,000
Average Annual Benefits	674,800	674,800	674,800	674,800	674,000	674,000	674,000	674,000	674,000
Net Average Annual Benefits	-404	-126,400	-190,200	-3,275,400	-16,400	-193,800	84,300	3,800	-3,081,000
Benefit-Cost Ratio	0.63	0.84	0.78	0.21	0.98	0.78	1.14	1.01	0.18

[1]Costs do not include landscaping, planting and seeding, beautification, rustication or recreation facilities.

In addition, the diversion alternative would have short-term adverse effects on the quality and aesthetics along the routes of the various diversions. The Jersey and 32nd Avenue diversion along the North Branch and the Culver Road diversion to Rice Lake would require substantial excavation along those residential streets to install the diversion interceptors. During the construction of those interceptors, the quality and aesthetics of the residential areas along these routes would suffer significant adverse effects until the construction and rehabilitation of the area was complete. The construction of these diversions would cause significant social disruption of these residential areas although wise construction practices could minimize adverse effects.

The diversion of the creek at Glenwood Avenue would have significant short-term adverse effects along the route of that diversion. The existing natural vegetation along much of this route would have to be removed for the construction of the diversion. The existing wildlife habitat along this diversion route would be temporarily disrupted during construction and during that period in which the area would be returning to its natural state. Although biologically this area is not particularly unique, the biological systems would be subject to considerable disruption during construction and for a period of time following the construction of this diversion. Generally, the flood storage and diversion alternative is an economically and environmentally acceptable alternative for flood damage reduction.

The flood storage and flood proofing alternative would also significantly reduce the adverse effects on the quality and aesthetics of Bassett Creek when compared to channel modifications. This alternative is similar to the flood storage-diversion alternative with respect to disruption of the stream channel. Although this alternative would not cause significant adverse effects on the aesthetics or quality of the creek, those residents being flood proofed or evacuated would suffer considerable disruption until flood proofing measures were completed or until they were relocated. Generally, the flood storage and flood proofing alternative is an economically, environmentally and socially acceptable flood control alternative.

All of the outlet alternatives offer and acceptable degree of flood damage reduction or compensation for incurred flood damages and enhance the economic or environmental welfare of the citizens of the Bassett Creek watershed. The repair of the existing conduit and all of the new conduit alternatives are comparable with respect to their environmental and social effects and generally the alternatives will have an insignificant effect on the quality and aesthetics of the existing stream environment. Economically, the outlet alternatives do differ slightly as shown on Table 1. The new conduit alternative along the Third Avenue distributor constructed in cooperation with the Minnesota Highway Department is the most cost effective. The range of the other outlet alternatives with respect to their economic feasibility would be; new conduit along Highway 94 to deep tunnel in cooperation with Minnesota Highway Department; repair of the existing conduit and; new conduit in non-highway right-of-way.

The open space-open channel corridor alternative as a replacement for the existing conduit would significantly enhance the quality and aeshtetics of the stream environment in the City of Minneapolis. The open space created would also result in land enhancement and recreational benefits in conjunction with the proposed redevelopment plan in the area. The magnitude of these benefits, however, cannot be quantified until more information regarding possible land use changes and population densities have been identified. The open space-open channel corridor outlet alternative is the most enviornmentally beneficial and is the most socially acceptable alternative to some of the people of the area.

ALTERNATIVES SELECTED FOR FURTHER ANALYSIS

Further development of any of the alternatives investigated must be based on evaluation of their contributions to the wise resource management for both short- and long-term needs of the Bassett Creek watershed. Their ability to satisfy the obvious needs for permanent flood damage reduction or compensation of incurred flood damages as well as their contributions to their specific plan formulation objectives are important considerations.

The nonstructural alternatives of permanent flood plain evacuation and flood proofing and partial evacuation by themselves are socially unacceptable and are economically infeasible and, therefore, do not warrant further consideration.

While no nonstructural alternative completely satisfies the specific objective of permanent flood damage reduction, certain nonstructural alternatives, when used to supplement structural flood control measures do provide practical solutions in certain reaches of the Bassett Creek watershed. The nonstructural plans which should be considered further as supplements to structural flood control measures are: 1) no action--maintain the base condition consisting of existing flood plain regulation, flood forecasting-flood warning and emergency protective measures and the availability of flood insurance for existing development as a datum from which other alternatives can be assessed and; 2) flood proofing and the evacuation of structures not suitable for flood proofing in areas which cannot be economically protected by other flood control measures.

All of the structural plans considered including channel modification, flood storage, diversion and the various outlet alternatives satisfy the specific objective of flood damage reduction. However, the various structural plans provide varying degrees of satisfaction to the other specific plan formulation objectives. Alternatives involving extensive channel modification are unacceptable to residents of the watershed and do not warrant further consideration. The repair of the existing conduit and all of the new conduit alternatives are comparable with respect to the degree of protection provided and their effects on the quality and aesthetics of the stream environment. However, the new conduit alternative along the Third Avenue distributor constructed in cooperation with the Minnesota Highway Department is the most cost effective, therefore, the only new conduit alternative which warrants further consideration. The open space-open channel corridor outlet alternative is the most socially acceptable alternative of the people in the area and is the most environmentally beneficial outlet alternative. The open space-open channel outlet alternative must, therefore, be considered further.

Of the alternatives investigated, the following alternatives merit further consideration and the following table ranks the alternatives according to how well each satisfies the specific planning objectives.

Nonstructural:

No action--maintain the base condition (flood plain regulation, flood forecasting-flood warning and flood insurance). (Alternate 1)

Structural:

Flood storage and diversion with a new conduit in Third Avenue distributor right-of-way and deep tunnel. (Alternate 5-C)

Flood storage and diversion with an open space-open channel corridor to the Mississippi River. (Alternate 5-E)

Combinations of Nonstructural and Structural:

Flood storage and flood proofing - partial evacuation with a new conduit in the Third Avenue distributor right-of-way and deep tunnel. (Alternate 6-C)

Flood storage and flood proofing - partial evacuation with an open space-open channel corridor to the Mississippi River. (Alternate 6-E)

CONTRIBUTIONS OF ALTERNATIVES TO NATIONAL OBJECTIVES

Formulating plans that contribute to the national objectives of national economic development and environmental quality is of a fair amount of importance in water resource planning. To achieve a balanced plan which reflects society's dual preference for improving national economic efficiency while maintaining and enhancing the natural environment, current guidelines require that a plan emphasizing national economic efficiency and a plan emphasizing the environmental quality objective be

Table 2

RANKING OF ALTERNATIVES

Specific Planning Objectives	High ← Plan Satisfaction Rating → Low				
a. Preserve quality of stream environment.	No Action--Maintain Base Condition (Alternate 1)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor (Alternate 6-E)	Flood Storage and Diversion - Open Channel Corridor (Alternate 5-E)	Flood Storage and Flood Proofing - Partial Evacuation New Conduit Along Third Avenue (Alternate 6-C)	Flood Storage and Diversion - New Conduit along Third Avenue (Alternate 5-C)
b. Flood damage reduction or compensation of losses	Flood Storage and Diversion - Open Channel Corridor or New Conduit Along Third Avenue (Alternates 5-E and 5-C)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor or New Conduit Along Third Avenue (Alternates 6-E and 6-C)	--	--	No Action--Maintain Base Condition (Alternate 1)
c. Social acceptibility	Flood Storage and Flood Proofing - Partial Evacuation New Conduit Along Third Avenue (Alternate 6-C)	Flood Storage and Diversion - New Conduit Along Third Avenue (Alternate 5-C)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor (Alternate 6-E)	Flood Storage and Diversion - Open Channel Corridor (Alternate 5-E)	No Action--Maintain Base Condition (Alternate 1)
d. Local economic welfare and security	Flood Storage and Flood Proofing - Partial Evacuation New Conduit Along Third Avenue (Alternate 6-C)	Flood Storage and Diversion - New Conduit Along Third Avenue (Alternate 5-C)	No Action--Maintain Base Condition (Alternate 1)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor (Alternate 6-E)	Flood Storage and Diversion - Open Channel Corridor (Alternate 5-E)

developed and displayed. Through a series of trade-offs among federal criteria and other societal preferences and trade-offs between the beneficial and adverse nature of impacts, the plan which contributes most to the national and local planning objectives is developed and further refined via the interactive planning process.

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

The NED plan maximizes net economic benefits while addressing the range of planning objectives. National economic benefits are determined by measuring and analyzing the net value of increase in the output of goods and services derived from the plan. Therefore, using the economic criteria outlined earlier, all alternatives are analyzed based on their respective contributions to providing increased gains on the national economic efficiency. Table 1 compares the flood damage reduction benefits and associated costs for each of the alternatives. The flood storage and flood proofing - partial evacuation with a new conduit along the Third Avenue distributor and deep tunnel alternative (Alternate 6-C) has the highest net benefits and benefit-cost ratio and this constitutes the national economic development plan.

ENVIRONMENTAL QUALITY (EQ) PLAN

The EQ plan addresses the planning objectives while emphasizing contributions to aesthetic, ecological and cultural values. Since the alternatives chosen for further analysis were formulated primarily for the flood damage reduction objective, it is necessary to evaluate these alternatives in the context of enhancing environmental quality to develop the most acceptable environmental quality plan. Development of the environmental quality plan is based on the following criteria:

a. Since alternatives were formulated based on satisfaction of the study objectives including the environmental and social well-being considerations and because the environmental quality plan

must also satisfy these objectives, the environmental quality alternative which will serve as a framework for the development of the environmental quality plan has already been evaluated.

b. The selected framework environmental quality alternative is that alternative which is initially least environmentally disruptive and the most environmentally beneficial to the existing flood plain area.

c. With the framework alternative selected, environmental enhancement measures and features to better fulfill the specific objectives are added incrementally to develop the most acceptable and environmentally beneficial plan.

An interdiscplinary team evaluated the plans for environmental quality including the beneficial and adverse contributions made by each alternative towards preserving, maintaining, restoring or enhancing significant environmental attributes of the study area. This interdiscplinary evaluation found the flood storage and flood proofing - partial evacuation with an open space-open channel corridor alternative (Alternate 6-E) to be among the most environmentally beneficial. Therefore, this alternative, with slight modification, is designated the framework environmental quality alternative.

The framework environmental quality alternative (Alternate 6-E) would result in some adverse social disruption effects due to evacuation and relocation of the existing residential and industrial development which lies along the route of the open space-open channel corridor. However, the framework environmental quality alternative will result in substantial offsetting beneficial environmental contributions. This alternative creates more open space in an urban commercial-industrial area. This open space improves the aesthetics and creates a passive recreational resource in this reach. The framework environmental quality alternative would result in land enhancement benefits when included as part of the redevelopment of this area. The recreational benefits and land enhancement cannot be quantitifed until more information regarding the proposed

redevelopment of the area including changes in land use and population densities are known. The City of Minneapolis has initiated a study to review possible redevelopment alternatives in this portion of north Minneapolis and although the study has not been completed, it is anticipated that the open space-open channel corridor will be included as part of the redevelopment alternatives for this area.

In that portion of the Bassett Creek watershed upstream of Irving Avenue (Mile 1.85), the interdisciplinary team determined that the flood storage and flood proofing - partial evacuation alternative with slight modification was the least environmentally disruptive. Flood storage minimizes the areas subject to construction during implementation of the project. Flood storage has minimum adverse effects on the fish and wildlife habitat throughout the watershed. The use of public lands and recreational open space areas makes multiple use of these lands in an urban area. Flood storage results in minimum adverse social disruption effects due to construction and implementation of the flood control project.

The interdisciplinary team identified several areas where slight modifications in the flood storage and flood proofing - partial evacuation alternative would better fulfill the environmental and social well-being criteria, be less environmentally disruptive or enhance environmental quality. Clearing and snagging would be eliminated in the reach from Bassett Creek Drive (Mile 5.14) to Highway 100 (Mile 6.44) to preserve the integrity of the existing aquatic and upland wildlife habitat in the Briarwood Bird Sanctuary and along the creek upstream of Minnaqua Avenue (Mile 5.94). Instead of clearing and snagging in this reach, nine additional homes would be flood proofed. To insure that the existing fish spawning characteristics of Medicine Lake will not be altered, the flood level would not be lowered. The existing outlet structure would be repaired to extend its useful life, however, the modification of the channel immediately downstream of the outlet structure would be eliminated. Instead of lowering the flood level on Medicine Lake, six homes would be flood proofed to reduce flood damage.

Other environmental enhancement measures were evaluated and identified by the interdisciplinary team for incorporation into the framework environmental quality alternative to develop the plan which best satisfies the national environmental quality objective. The specific environmental quality needs which could be preserved, maintained, restored or enhanced by inclusion of the measures in the framework environmental quality alternative include:

a. The need for protection and enhancement of the aesthetic values.

b. The need to enhance the recreational opportunities within the creek corridor.

While only plans incorporating structural measures can offer positive protection from flooding, these measures would adversely affect the view along the creek. In some areas restoration of existing aesthetic values following the construction of structural features would be sufficient, whereas, in other areas additional aesthetic enhancement is necessary. The beautification measures required include rustication of concrete structural features, additional landscaping, planting and seeding and general beautification of areas affected by the construction of structural features. These areas include the banks of the creek between Dupont and Glenwood, the flood wall and retaining wall just downstream of Glenwood Avenue, the Rice Lake area particularly where demolition debris is removed or covered, the Bassett Creek Park area, and along the North Branch between Douglas Drive and Louisiana Avenue.

To enhance the recreational opportunities and further enhance the aesthetic quality of the environmental quality plan, approximately 17,000 lineal feet of paved bike path and walkway are included between Theodore Wirth Park and the Mississippi River along the creek. The proposed bike path and walkway would follow the creek along the existing corridor and along the proposed open space-open channel corridor. Numerous paved ramps leading to and from the proposed bike path and walkway would be provided at several key city streets and wherever the corridor lies adjacent to existing public use lands and facilities.

In summary, the environmental quality plan would include the features of the flood storage and flood proofing - partial evacuation with an open space-open corridor alternative (Alternate 6-E) with the following modifications:

a. Eliminate clearing and snagging in the reach from Bassett Creek Drive to Highway 100 and flood proof nine additional homes in this reach to preserve the existing aquatic and upland wildlife habitat.

b. Flood proof homes around Medicine Lake to preserve the existing fish spawning characteristics of the lake.

c. Include approximately 17,000 lineal feet of asphalt bike path and walkway along the creek corridor from the Mississippi River to Theodore Wirth Park.

d. Include extensive beautification measures in the area of all flood control features.

DEVELOPMENT OF THE SELECTED PLAN

The flood storage and flood proofing - partial evacuation with a new conduit along the Third Avenue distributor right-of-way and deep tunnel alternative (Alternate 6-C) is selected as the water and related land resource management alternative which would best satisfy all planning objectives both specific and national for the Bassett Creek watershed. Of the considered alternatives, it would provide 100-year flood protection and has the highest net benefits and benefit-cost ratio. This alternative would provide flood protection for all existing development in the flood plain of the watershed. Future development in the flood plain areas which are not protected by structural features of this plan will be subject to the no action--maintain the base condition alternative consisting of flood plain regulation, flood forecasting-flood warning and flood insurance. The selected plan (Alternate 6-C) would include flood

proofing of nine additional homes in the reach from Bassett Creek Drive (Mile 5.14) to Highway 100 (Mile 6.44) in lieu of clearing and snagging, approximately 1.9 miles of bike paths and walkways and beautification measures at certain locations.

The selected plan differs from the environmental quality framework alternative in the reach from the Mississippi River to Irving Avenue (Mile 1.85) and at Medicine Lake. Because flood proofing is socially unacceptable to residents around the lake and to preserve the fish spawning characteristics of Medicine Lake, the outlet structure would be relocated approximately 500 feet downstream to Mile 12.01. At this location, the structure would not affect normal spring high water levels, but would provide additional discharge capacity at higher than normal spring water levels. This alternative for reducing flood damages around Medicine Lake would cost approximately $15,000 more than the environmental quality framework alternative and approximately $20,000 more than the national economic development plan, however, it is the only plan which is both environmentally and socially acceptable.

COMPARISON OF IDENTIFIED PLANS

A comparison of alternative plans consists of a series of trade-offs and iterations to analyze contributions of each plan to the planning objectives, national accounts, Federal interests and other important evaluation criteria as appropriate. This type of comparison categorizes various impacts and displays each plan in terms of the components of the system of accounts.

The following table identifies the national economic development, the environmental quality and selected plans with respect to this anlaysis. In this table, the plans are compared so that the impacts measured in dissimilar units can be traded-off against one another. This analysis provides the basis for developing the selected plan and identifies any previously unforeseen developments.

SCALE OF DEVELOPMENT

To permit selection of the optimum economic level of flood protection for the Bassett Creek watershed, costs and benefits were evaluated for four degrees of flood protection that would be provided by varying the design flood for the flood control project. Plan optimization data for the 50-year, 100-year and 500-year standard project flood are summarized in the following table and are shown on plate D-5. Annual benefits and costs shown in the table are based on a 100-year economic life and a 6-1/8 percent interest rate.

An optimum economic relationship exists when flood protection is provided against a flood having a recurrence interval on the order of once in 80 years. Protection from a flood having a recurrence interval of once in 100 years was selected as the level of protection to be provided because it is the minimum desirable level of flood protection in urban areas and is in accord with State and Federal flood plain management cirteria. The incremental benefits to cost ratio would be reduced slightly to approximately 0.95 if 100-year protection is provided. Higher degrees of flood protection are not economically feasible and there are no flood barriers included in the plan, therefore, Standard Project Flood protection was not considered.

Table 3
Plan Optimization Summary

Flood Frequency	Annual Cost	Annual Benefits	Net Benefits	Benefits-Cost Ratio
10%	$ 500,000	$484,000	$ -16,000	0.97
2%	570,000	619,000	49,000	1.09
1%	623,000	674,000	51,000	1.08
.2%	1,325,000	740,000	-585,000	0.56
Std. Proj.	4,519,000	760,000	-3,759,000	0.17

SYSTEM OF ACCOUNTS

	NED Plan		NR Plan		Selected Plan	
Plan Description	A. Flood storage and flood proofing - partial evacuation with a new conduit in Third Avenue distributor right-of-way and deep tunnel (Alternate 6-C). B. No action--maintain base condition consisting of flood plain regulation, flood insurance and flood forecasting-flood warning (Alternate 1) for Sweeney Lake Branch, North Branch upstream of Louisiana Avenue North and Plymouth Creek upstream of Medicine Lake.		A. Flood storage and flood proofing - partial evacuation with an open space-open channel corridor to the Mississippi River (Alternate 6-E) B. Same as NED plan. C. Retain the old Penn Avenue box culvert for aesthetics. D. Approximately 17,000 feet of bike path and walkway along creek corridor from Mississippi River to Theodore Wirth Park. E. Use of extensive beautification measures in the area of all structural flood control features. F. Eliminate clearing and snagging in reach from Golden Valley Road to T.H. 100. G. Flood proof homes around Medicine Lake.		A. Same as NED plan. B. Same as NED plan. C. Approximately 10,000 feet of bike path and walkway from inlet of proposed conduit along creek corridor to Glenwood Avenue and from creek corridor via a bridge across railroad tracks to Bryn Mawr Meadows Park. D. Use of extensive beautification measures in the area of all structural flood control features. E. Eliminate clearing and snagging in reach from Golden Valley Road to T.H. 100. F. Modified Medicine Lake outlet structure.	
	Location of Impacts		Location of Impacts		Location of Impacts	
	Within Project Area (1)	Within Rest of Nation	Within Project Area (1)	Within Rest of Nation	Within Project Area (1)	Within Rest of Nation
Accounts:						
1. National Economic Development						
a. Beneficial Impacts						
(1) Value of increased outputs of goods and services	Average annual flood damage reduction benefits $674,100. 1, 9 (2)	0	Total average annual flood reduction benefits $674,100. 1, 9 (2)	0	Total average annual flood damage reduction benefits $674,100. 1, 9 (2)	0
(2) Total NED benefits	$674,100. 1, 9	0	$674,100	0	$674,100	0
b. Adverse Impacts						
(1) Project costs	Total average annual costs $579,700. 1, 9 Non-Federal average annual cost $166,100. Federal average annual cost $413,600.	0	Total average annual cost $3,743,000. 1, 9 Non-Federal average annual cost $3,181,000. Federal average annual cost $561,400.	0	Total average annual costs $633,000. 1, 9 Non-Federal average annual cost $189,000. Federal average annual cost $444,000.	0
(2) Total NED costs	$579,700	0	$3,743,000	0	$633,000	0
c. Net NED benefits	$84,300 B/C = 1.14. 1, 9	0	-3,081,000 B/C = 0.18. 1, 9	0	$41,100 B/C = 1.06. 1, 9	0
2. Environmental Quality						
a. Environmental quality enhanced						
(1) Lakes	100-year flood level reduced 0.5 feet on Medicine Lake and 1.5 feet on Wirth Lake. 1, 9	--	100-year flood level reduced 1.5 feet on Wirth Lake. 1, 9	--	100-year flood level reduced 0.5 feet on Medicine Lake and 1.5 feet on Wirth Lake. 1, 9	--
(2) Archaeological	Archaeological sites possibly present - effects unknown- - - -		Archaeological sites possibly present - effects unknown- - - -		Archaeological sites possibly present - effects unknown- - - -	
(3) Aesthetic values*	Clearing and snagging along creek from Dupont to Penn Avenues would enhance the aesthetics in this reach. Covering of demolition debris in Rice Lake area would enhance aesthetics. 1, 9	--	Open space-open channel corridor would enhance the aesthetics in the outlet reach. -2, 5, 11 Clearing and snagging along creek from Dupont to Penn Avenues would enhance the aesthetics in this reach. Covering of demolition debris in Rice Lake area would enhance aesthetics. Beautification measures would further enhance reaches subject to clearing and snagging, the Rice Lake area where demolition debris would be covered and all other project features. 1, 9	--	Clearing and snagging along creek from Dupont to Penn Avenues would enhance aesthetics in this reach. Covering of demolition debris in Rice Lake area would enhance aesthetics. Beautification measures would further enhance reaches subject to clearing and snagging, Rice Lake area where demolition debris would be covered and all other project features. 1, 9	--
(4) Land quality	About 3 acres occupied by embankments for flood storage control structures. Plan removes about 160 acres from the 100-year flood plain. 1, 9	--	Significant enhancement of land quality in area surrounding open space-open channel corridor depending on future redevelopment plans. 2, 5, 11 About 40 acres removed from commercial-industrial use for open space-open channel corridor. About 3 acres occupied by embankments for flood storage control structures. Plan removes about 150 acres from 100-year flood plain. 1, 9	--	- - - - - - - - - - - -Same as NED plan- - - - - - - - - - - -	
(5) Urban open space	Existing urban open space enhanced by clearing and snagging between Dupont and Penn Avenues. Open space at Rice Lake enhanced by covering of demolition debris. Enhancement of approximately 20 acres of urban open space at inlet to new conduit. 1, 9	--	About 60 acres of urban open space created by open space-open channel corridor. Existing urban open space enhanced by clearing and snagging and beautification between Dupont and Penn Avenues. Open space at Rice Lake enhanced by covering of demolition debris. 1, 9	--	- - - - - - - - - - - -Same as NED plan- - - - - - - - - - - -	
(6) Stream bank erosion	Minor decrease in erosion anticipated due to velocity	--	Minor decrease due to velocity reduction of peak flood flows in channel and overbank areas	--	- - - - - - - - - - - -Same as NED plan- - - - - - - - - - - -	

(6) Stream bank erosion	Minor decrease in erosion anticipated due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	—	Minor decrease due to velocity reduction of peak flood flows in channel and overbank areas and due to use of riprap in critical areas. 1, 9	--	-Same as NED plan-
(7) Biological resources*	Some biological enhancement would result from covering of demolition debris at Rice Lake. Creation of wetland at conduit inlet.	—	Undeterminable number of trees and shrubs would be planted along open space-open channel corridor. Some biological enhancement would result from covering of demolition debris at Rice Lake. 1, 9	--	-Same as NED plan-
(8) Rare and endangered species	-No known effect-		-No known effect-		-No known effect
(9) Ecological systems*					
Terrestrial	Enhancement of terrestrial habitat due to covering of demolition debris at Rice Lake. 1, 9	—	Gain in urban open space habitat results from open space-open channel corridor. Enhancement of terrestrial habitat due to covering of demolition debris at Rice Lake. 1, 9	--	-Same as NED plan-
Aquatic	Drop structure in new conduit would prevent migration of undesirable rough fish species from the Mississippi River into Bassett Creek as well as to the lakes and ponds in the watershed.	--	-No known enhancement effect-		-Same as NED plan-
b. Environmental Quality Degraded					
(1) Archaeological	Archaeological sites possibly present - effects unknown-		Archaeological sites possibly present - effects unknown-		Archaeological site possily present - effects unknown-
(2) Aesthetic values*	Embankments for flood storage control structures would degrade existing aesthetics of area, contouring them into natural topography, landscaping and plantings would at least partially offset adverse effects. 1, 9, 5	--	Embankments for flood storage control structures would degrade existing aesthetics of area contouring into the natural topography, landscaping and plantings and beautification measures would at least partially offset adverse effects. 1, 9	--	Embankments for flood storage control structures would degrade existing aesthetics of area, contouring into natural topography, landscaping, plantings and beautification measures would at least partially offset adverse effects. 1, 9
(3) Urban open space	Increased flood storage on existing open space such as golf courses, natural areas and parks will restrict their use for up to 2 days longer following a flood period as a result of the plan. 1, 9	—	Increased flood storage on existing open space use as golf course, natural areas, and parks will restrict their use for up to 2 days longer following a flood period as a result of the plan. 1, 9	—	-Same as NED plan-
(4) Air quality and noise*	Minor degradation for the duration of construction. 1, 9	—	Minor degradation caused by construction. 1	--	-Same as NED plan-
(5) Water quality*	Minor degradation for the duration of construction. 1, 9	--	Minor degradation over the duration of construction. 1	—	-Same as NED plan-
(6) Biological resources*	Temporary degradation of brush, turfed and natural areas during construction, areas would be reestablished naturally or with plantings following construction. 1, 9, 6	—	Temporary degradation of brush, turfed and natural area during construction would be reestablished naturally or with plantings following construction. 1, 9, 6	—	-Same as NED plan-
(7) Ecological systems*					
Terrestrial	Temporary loss of small areas of habitat during construction. 1, 9	—	Temporary loss of small areas of habitat during construction. 1, 9	—	-Same as NED plan-
Aquatic	Minor effects caused by construction (siltation and turbidity). 1, 9 Drop structure in new conduit would prevent migration of game fish species from the Mississippi River into Bassett Creek. 1, 9 Development of flood storage area between Douglas Drive and Louisiana Avenue on the North Branch would temporarily effect the benthic organisms and microfauna in this intermittent stream. 5 Possible adverse effects on fish spawning in Medicine Lake due to reduction of normal spring water levels.	—	Minor effects caused by construction (siltation and turbidity). 1, 9 Development of flood storage area between Douglas Drive and Louisiana Avenue on the North Branch would temporarily effect the benthic organisms and microfauna in this intermittent stream. Flood proofing homes around Medicine Lake would maintain existing fish spawning characteristics of the lake.	--	Minor effects caused by construction (siltation and turbidity). 1, 9 Drop structure in new conduit would prevent migration of game fish species from the Mississippi River into Bassett Creek. 1, 9 Development of flood storage area between Douglas Drive and Louisiana Avenue on the North Branch would temporarily effect the benthic organisms and microfauna in this intermittent stream. Modified Medicine Lake outlet structure would not effect normal spring water levels thus maintaining existing fish spawning characteristics of the lake.
c. Environmental Quality Destroyed					
(1) Archaeological	Archaeological sites possibly present - effects unknown-		Archaeological sites possibly present - effects unknown-		Archaeological sites possily present - effect unknown-
(2) Biological resources*	An undetermined but small number of trees would be removed for construction, long-term adverse effects would be minimized by new plantings in these areas. 1, 9	--	An undetermined, but relatively small number of trees would be removed for construction, long-term adverse effects would be minimized by new plantings in the areas. 1, 9	—	- Same a EQ Plan
(3) Preservation of freedom of choice for future resource use*	Curtailment of future options for resources committed. 1, 9, 5	--	Curtailment of future options for resources committed. 1, 6, 9	--	Curtailment of future options for resources committed. 1, 5, 9
3. Social Well-Being					
a. Beneficial Impacts					
(1) Enhancement of health, safety and community well-being	About 220 homes and 18 businesses protected from 100-year flood. Reduced community disruption as a result of 100-year flood protection	--	About 220 homes and 18 businesses protected from 100-year flood. Reduced community disruption as a result of 100-year flood protection.	—	-Same as NED plan-

	Possible adverse effects on fish spawning in Medicine Lake due to reduction of normal spring water levels.			Modified Medicine Lake outlet structure would not effect normal spring water levels thus maintaining existing fish spawning characteristics of the lake.
c. Environmental Quality Destroyed				
(1) Archaeological	Archaeological sites possibly present - effects unknown	--	Archaeological sites possibly present - effects unknown	-- Archaeological sites possibly present - effect unknown --
(2) Biological resources[a]	An undetermined but small number of trees would be removed for construction, long-term adverse effects would be minimized by new plantings in these areas. 1, 9	--	An undetermined, but relatively small number of trees would be removed for construction, long-term adverse effects would be minimized by new plantings in the areas. 1, 9	-- Same a EQ Plan --
(3) Preservation of freedom of choice for future resource use[a]	Curtailment of future options for resources committed. 1, 9, 5	--	Curtailment of future options for resources committed. 1, 6, 9	-- Curtailment of future options for resources committed. 1, 5, 9 --
3. Social Well-Being				
a. Beneficial Impacts				
(1) Enhancement of health, safety and community well-being	About 220 homes and 18 businesses protected from 100-year flood. Reduced community disruption as a result of 100-year flood protection. Reduced threat to life, health and safety of residents as a result of 100-year flood protection. 1, 9	--	About 220 homes and 18 businesses protected from 100-year flood. Reduced community disruption as a result of 100-year flood protection. Reduced threat to life, health and safety of residents as a result of 100-year flood protection. 1, 9	-- -Same as NED plan- --
(2) Educational, cultural, and recreation opportunities	Reduced 100-year flood levels on Medicine Lake and Wirth Lake reduces the flood damages to beaches and reduces the recreation opportunities lost as a result of flooding. 1, 9	--	Reduced 100-year flood level on Medicine Lake and Wirth Lake reduce the flood damage to beaches and reduce recreation opportunities lost at beaches as a result of flooding. Biking and hiking trails along creek from Mississippi River to Glenwood Avenue increases recreational opportunities. Open space-open channel corridor from Mississippi River to Dupont would create recreation opportunities in the area with limited existing opportunities. 1, 5, 9	-- Reduced 100-year flood levels on Medicine Lake and Wirth Lake reduce the flood damage to beaches and reduce recreational opportunities lost at beaches as a result of flooding. Biking and hiking trails along creek between Dupont and Glenwood Avenues increases recreational opportunities. Flood storage area at inlet of new conduit would increase passive or active recreation opportunities during non-flood periods. 1, 9 --
b. Adverse Impacts				
(1) Degraded education, cultural and recreational opportunities	Increased flood storage on Theodore Wirth, Golden Valley, and Brookview golf courses, and Rice Lake natural area and on Bassett Creek Community Park would result in up to 2 days of additional disruption of passive and active recreational activities following flood periods. 1, 9	--	Increased flood storage on Theodore Wirth, Golden Valley, and Brookview Community golf courses, on Rice Lake natural area and on Bassett Creek Community Park would result in up to 2 days of additional disruption of passive and active recreation activities following a flood period. 1, 9	-- -Same as NED plan- --
(2) Injurious displacement of people and community disruption[a]	Minor community disruption would result during flood proofing modifications and during construction of other plan features. Approximately 3 homes and 12 people requiring evacuation and relocation. 1, 9	--	Minor community disruption would result during flood proofing modifications and during construction of other plan features. 1, 9 Numerous business and multiple family buildings would be eliminated and would result in displacement and relocation of businesses and residents due to open space-open channel corridor.	-- -Same as NED plan- --
4. Regional Development				
a. Beneficial Impacts				
(1) Value of increased income	-Not evaluated-		-Not evaluated-	-Not evaluated --
(2) Quantity of increased employment[a]	-Not evaluated-		-No determinable effect	-Not evaluated --
(3) Desirable population distribution[a]	-Not evaluated-		-Not evaluated-	-No determinable effect- --
(4) Increased stability of regional economic growth	-Not evaluated-		-Not evaluated-	-Not evaluated --
b. Adverse Impacts				
(1) Value of income lost	-Not evaluated-		-Not evaluated-	-Not evaluated- --
(2) Quality of jobs lost	-Not evaluated-		-Not evaluated-	-No known effect- --
(3) Undesirable growth[a]	-Not evaluated-		-No determinable effect	-No determinable effects- --

Index of footnotes:
(1) Project area includes the watershed and the nine communities. (2) Not including advanced replacement benefits of $162,000, recreation benefits of $28,000 and redevelopment benefits of $85,000.

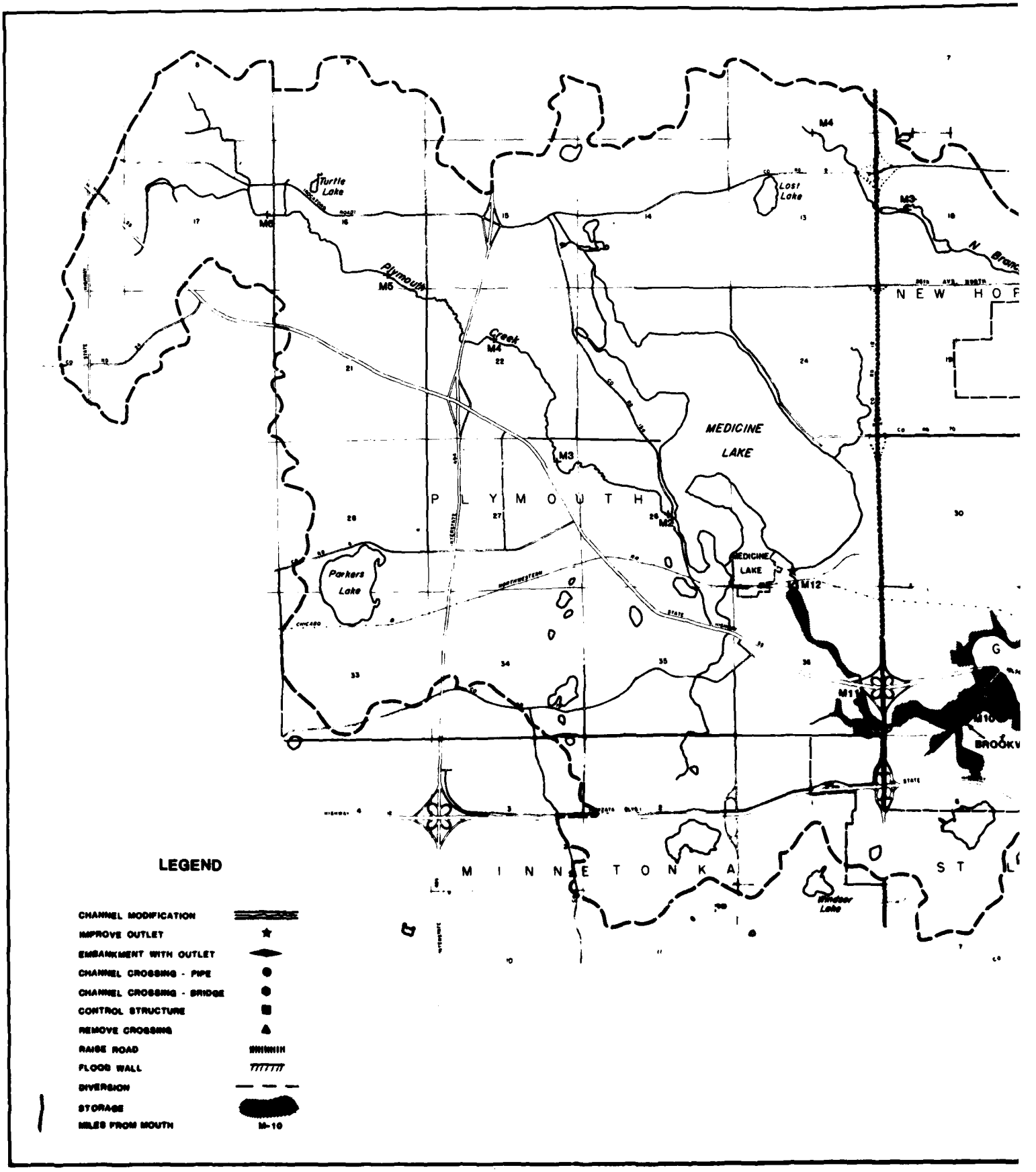
Timing
1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

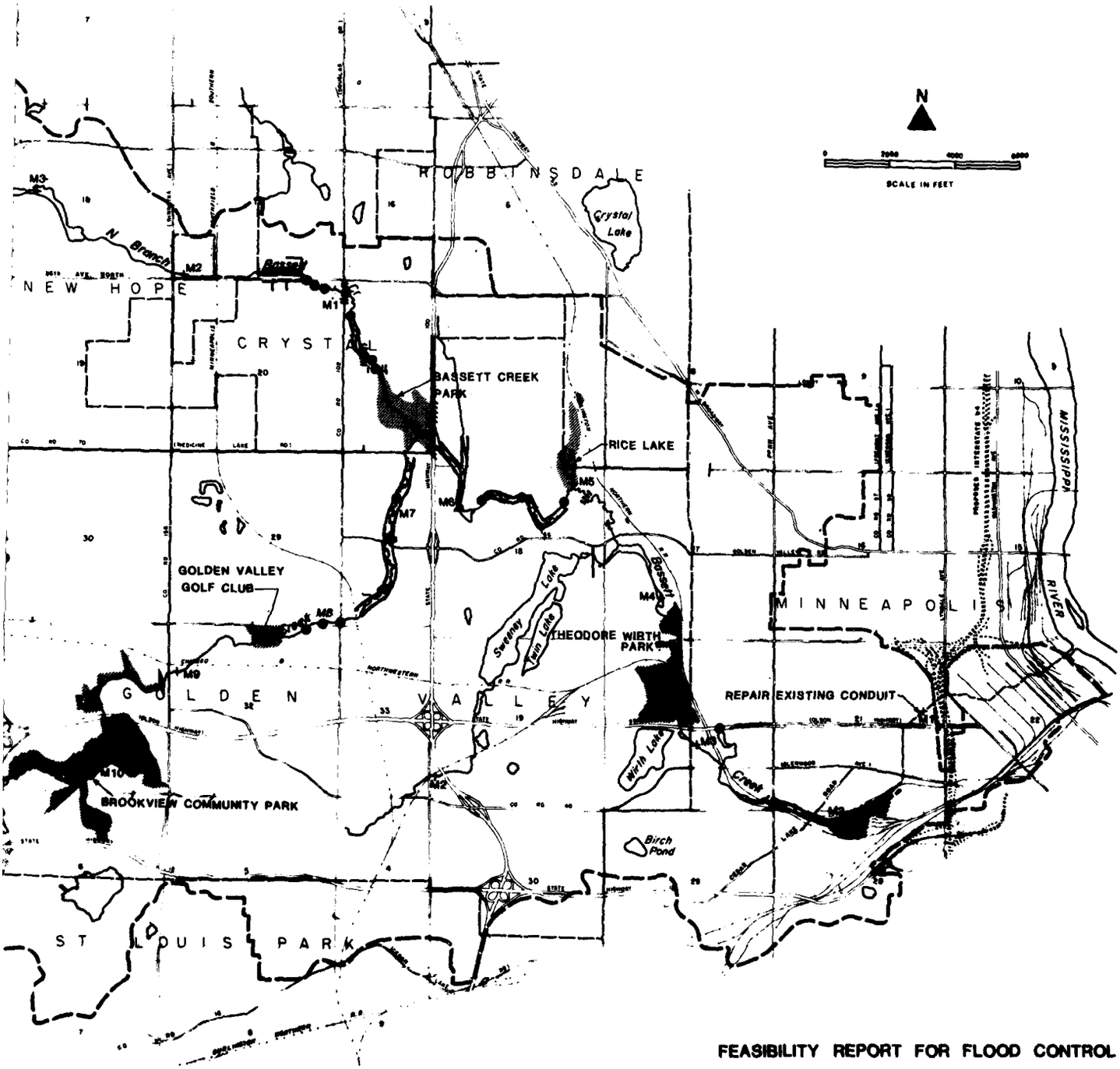
Uncertainty
4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Significance
7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality
9. Impact will occur for implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

Section 122
[a] Items specifically required in Section 122 and HR1105-2-105.


Turtle Lake
Lost Lake
Plymouth
Creek
M6
M5
M4
M3
M2
M12
MEDICINE LAKE
Parkers Lake
P L Y M O U T H
M I N N E T O N K A
NEW HOP
LEGEND
CHANNEL MODIFICATION
IMPROVE OUTLET
EMBANKMENT WITH OUTLET
CHANNEL CROSSING - PIPE
CHANNEL CROSSING - BRIDGE
CONTROL STRUCTURE
REMOVE CROSSING
RAISE ROAD
FLOOD WALL
DIVERSION
STORAGE
MILES FROM MOUTH
M-10



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

FLOOD STORAGE AND CHANNEL MODIFICATION ALTERNATIVE

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/10 MARCH 1976

2

PLATE D-1

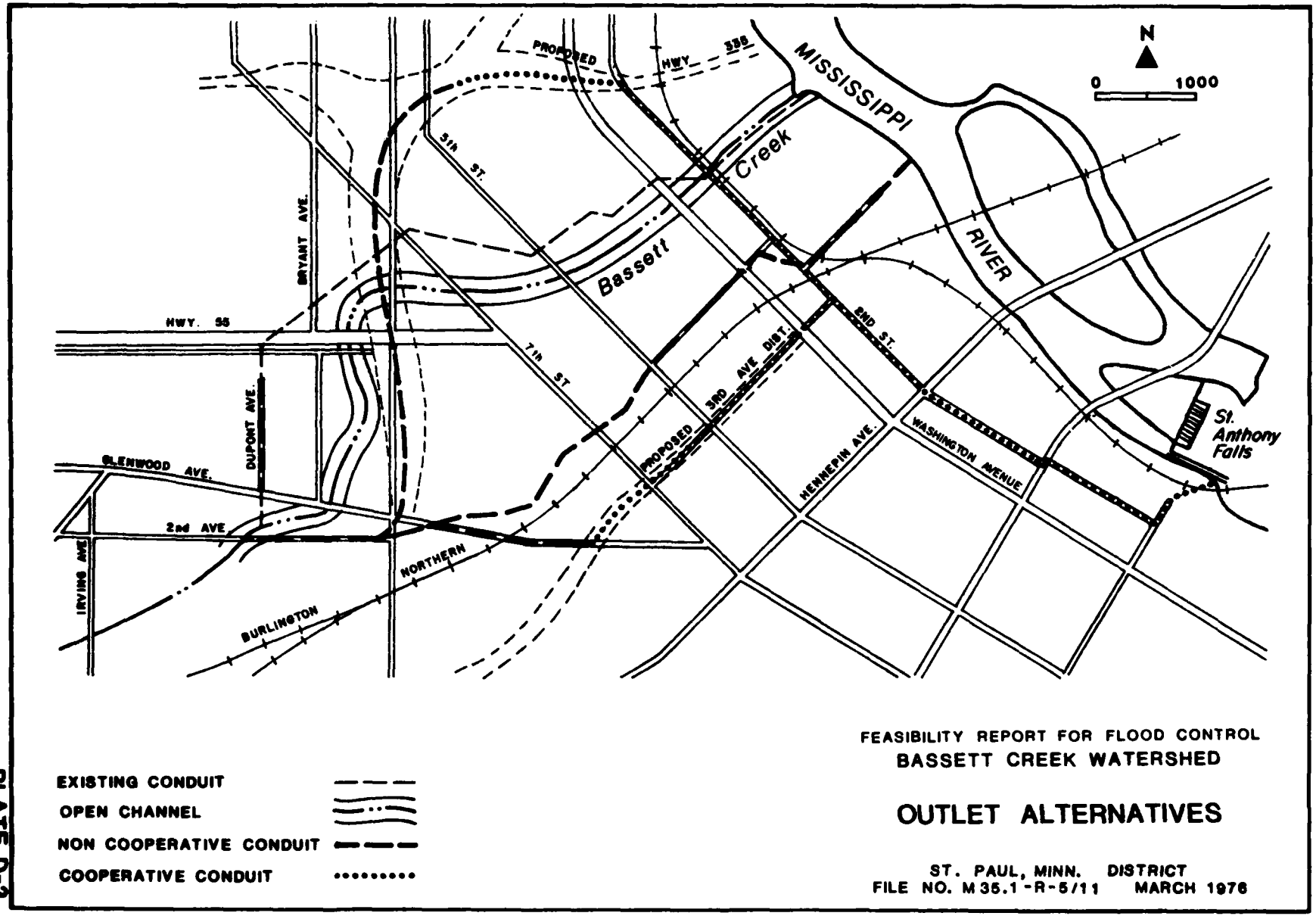
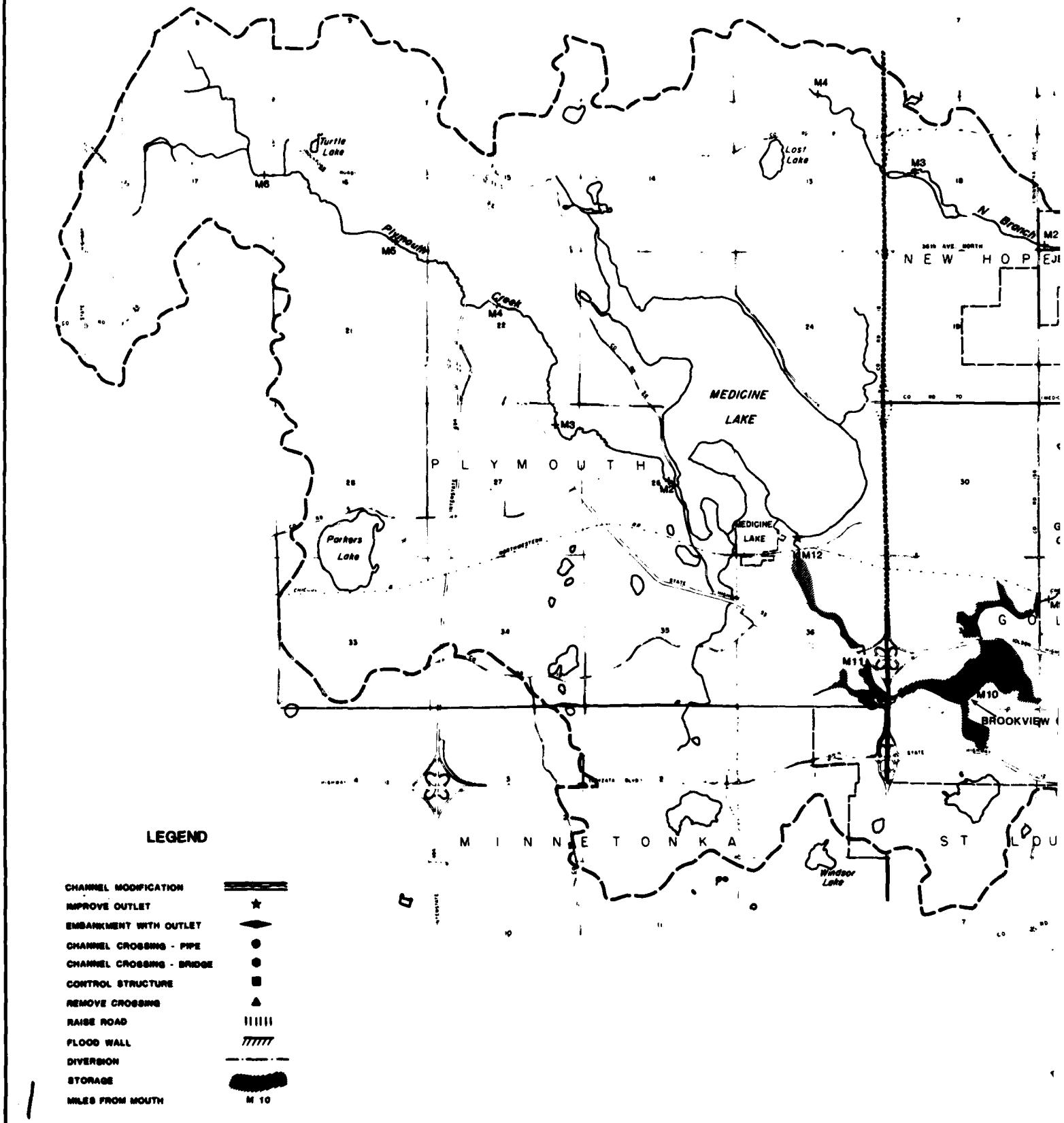
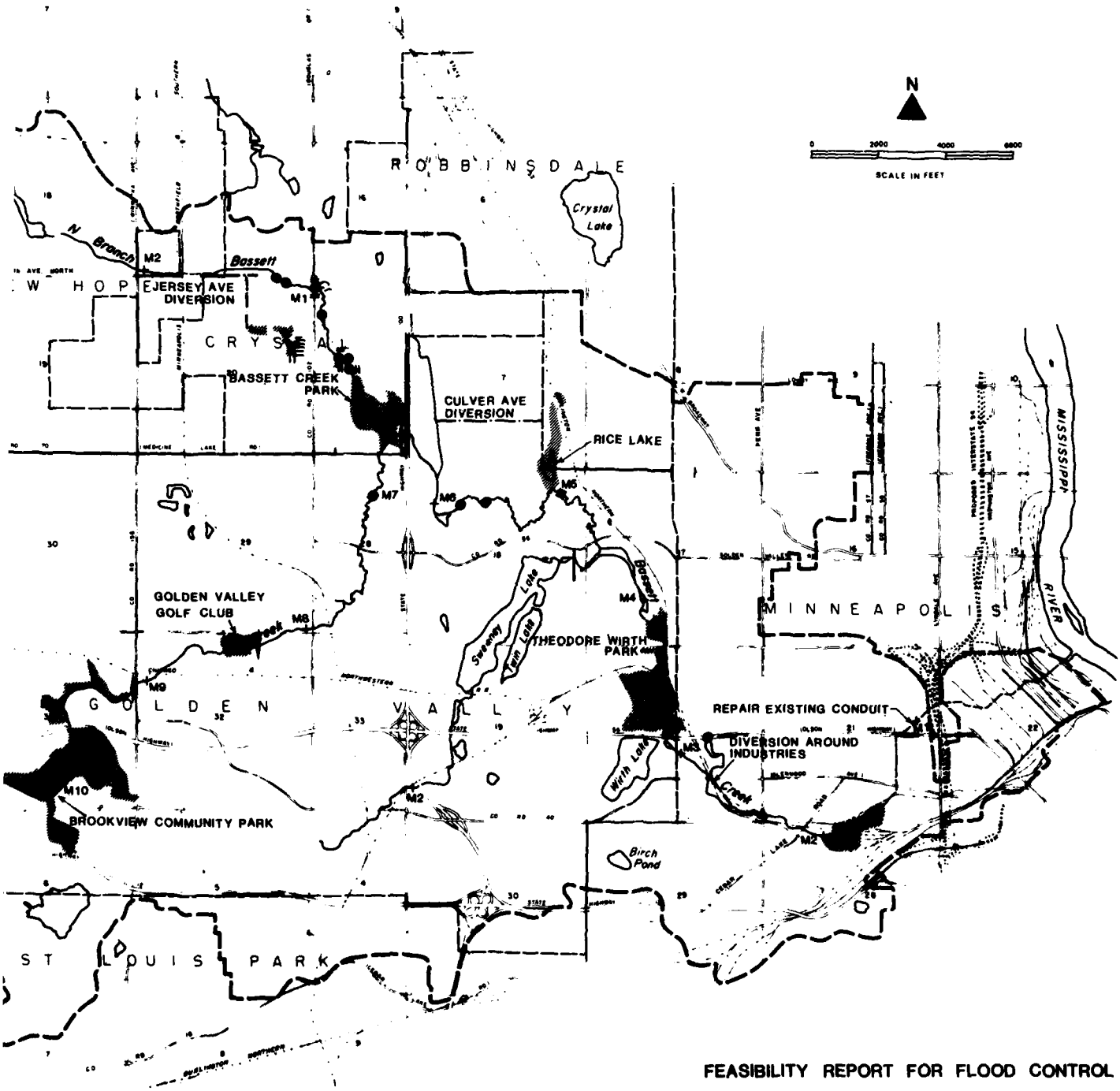

N
0
1000
PROPOSED
HWY
394
MISSISSIPPI
RIVER
Creek
Bassett
51th ST.
BRYANT AVE.
HWY. 55
7th ST
DUPONT AVE.
GLENWOOD AVE.
2nd AVE
IRVING AVE
NORTHERN
BURLINGTON
PROPOSED
3RD AVE DIST.
ENID ST.
HENNEPIN AVE.
WASHINGTON AVENUE
St.
Anthony
Falls
EXISTING CONDUIT
OPEN CHANNEL
NON COOPERATIVE CONDUIT
COOPERATIVE CONDUIT
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED
OUTLET ALTERNATIVES
ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/11 MARCH 1976

PLATE D-2


Turtle Lake
Lost Lake
M6
M5
M4
M3
M2
M12
M11
M10
Plymouth Creek
N Branch
MEDICINE LAKE
Parkers Lake
PLYMOUTH
NEW HOPE
BROOKVIEW
MINNETONKA
Windsor Lake
LEGEND
CHANNEL MODIFICATION
IMPROVE OUTLET
EMBANKMENT WITH OUTLET
CHANNEL CROSSING - PIPE
CHANNEL CROSSING - BRIDGE
CONTROL STRUCTURE
REMOVE CROSSING
RAISE ROAD
FLOOD WALL
DIVERSION
STORAGE
MILES FROM MOUTH
M 10



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

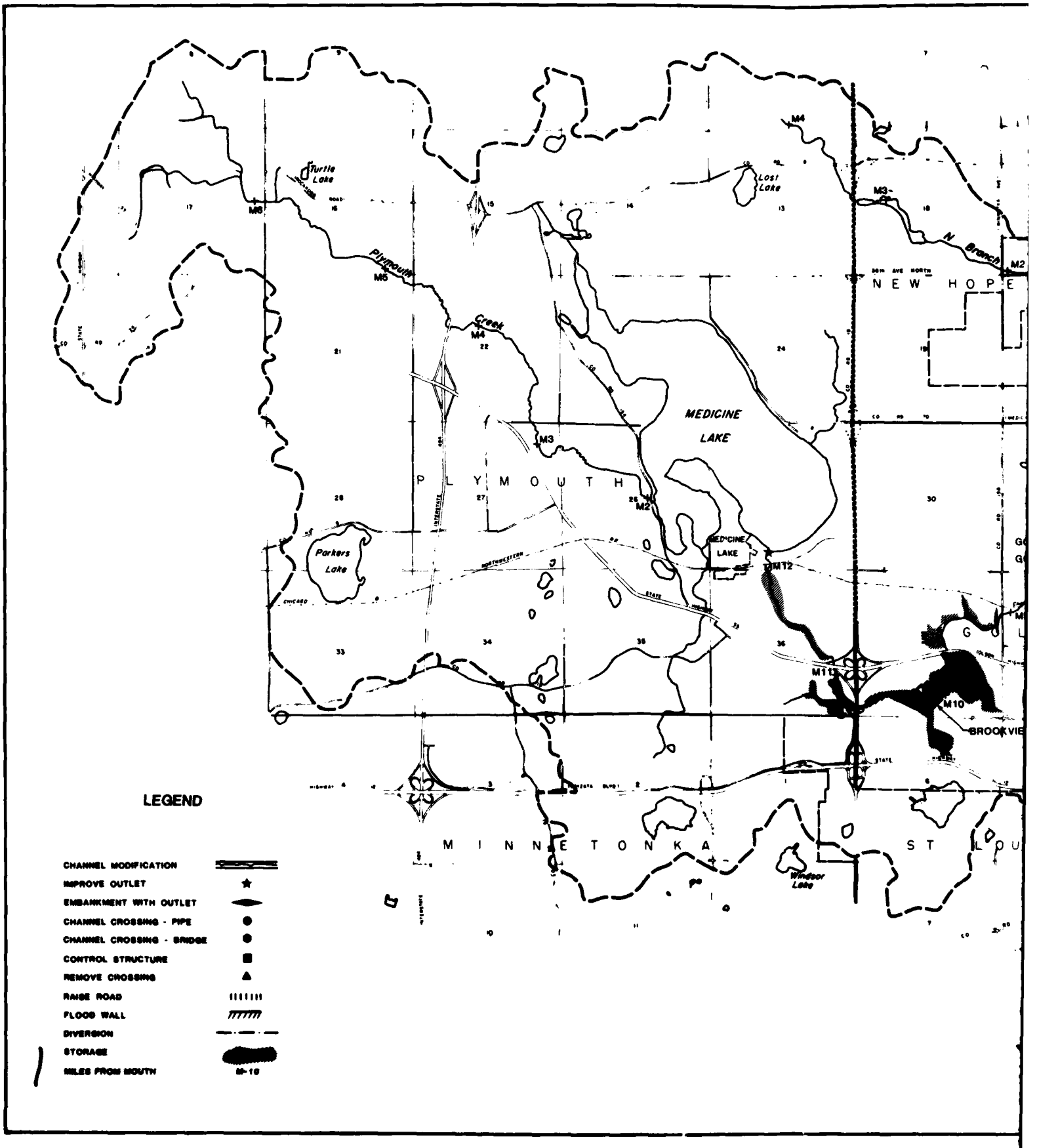
DIVERSION AND FLOOD STORAGE ALTERNATIVE

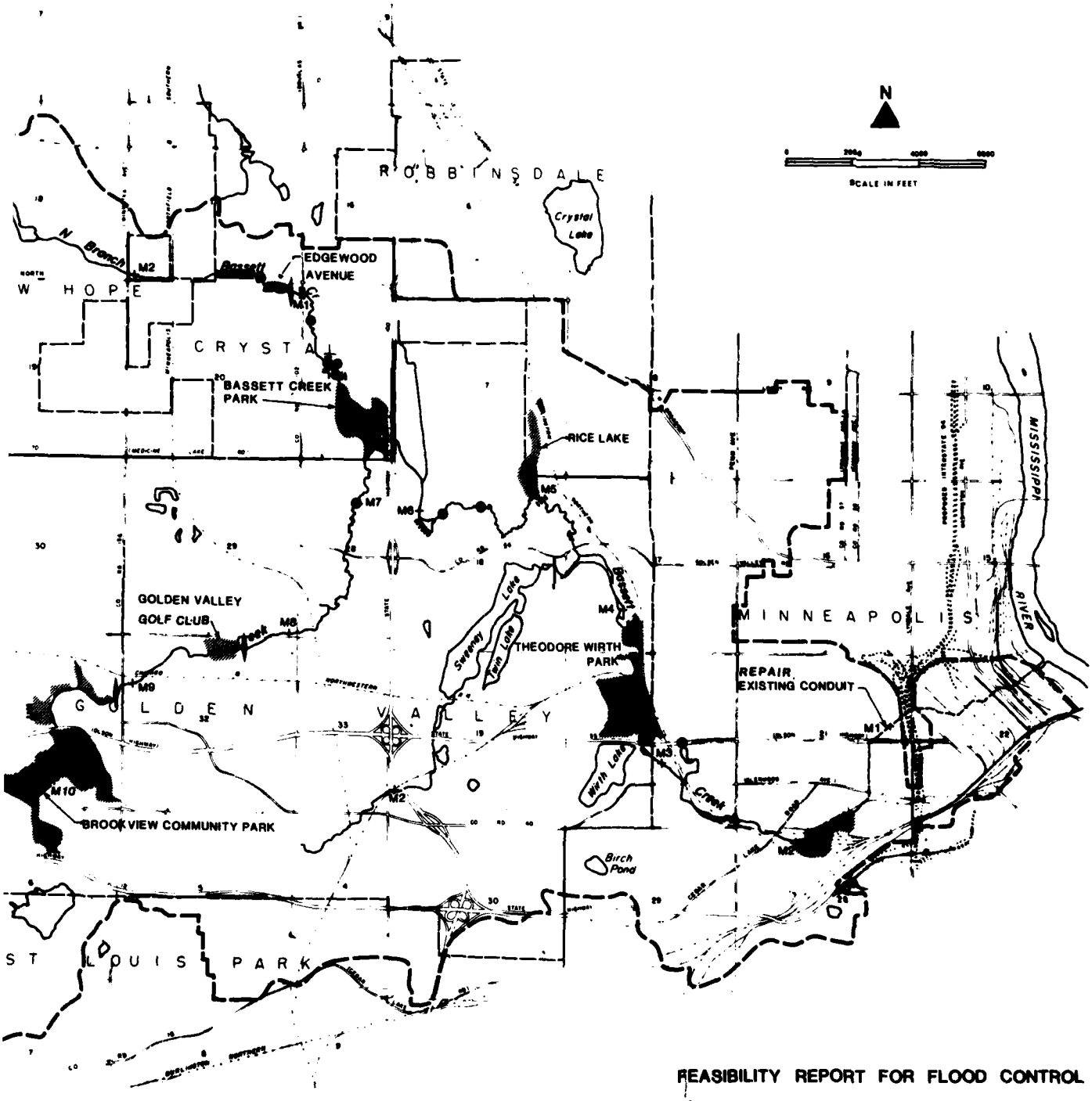
ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/12 MARCH 1976

2

PLATE D-3


Turtle Lake
Lost Lake
M6
M5
M4
M3
M2
M1
Plymouth Creek
N Branch
NEW HOPE
MEDICINE LAKE
PLYMOUTH
Parkers Lake
MEDICINE LAKE
M12
M11
M10
BROOKVIE
MINNETONKA
ST LOU
Whaler Lake
LEGEND
CHANNEL MODIFICATION
IMPROVE OUTLET
EMBANKMENT WITH OUTLET
CHANNEL CROSSING - PIPE
CHANNEL CROSSING - BRIDGE
CONTROL STRUCTURE
REMOVE CROSSING
RAISE ROAD
FLOOD WALL
DIVERSION
STORAGE
MILES FROM MOUTH
M-10



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

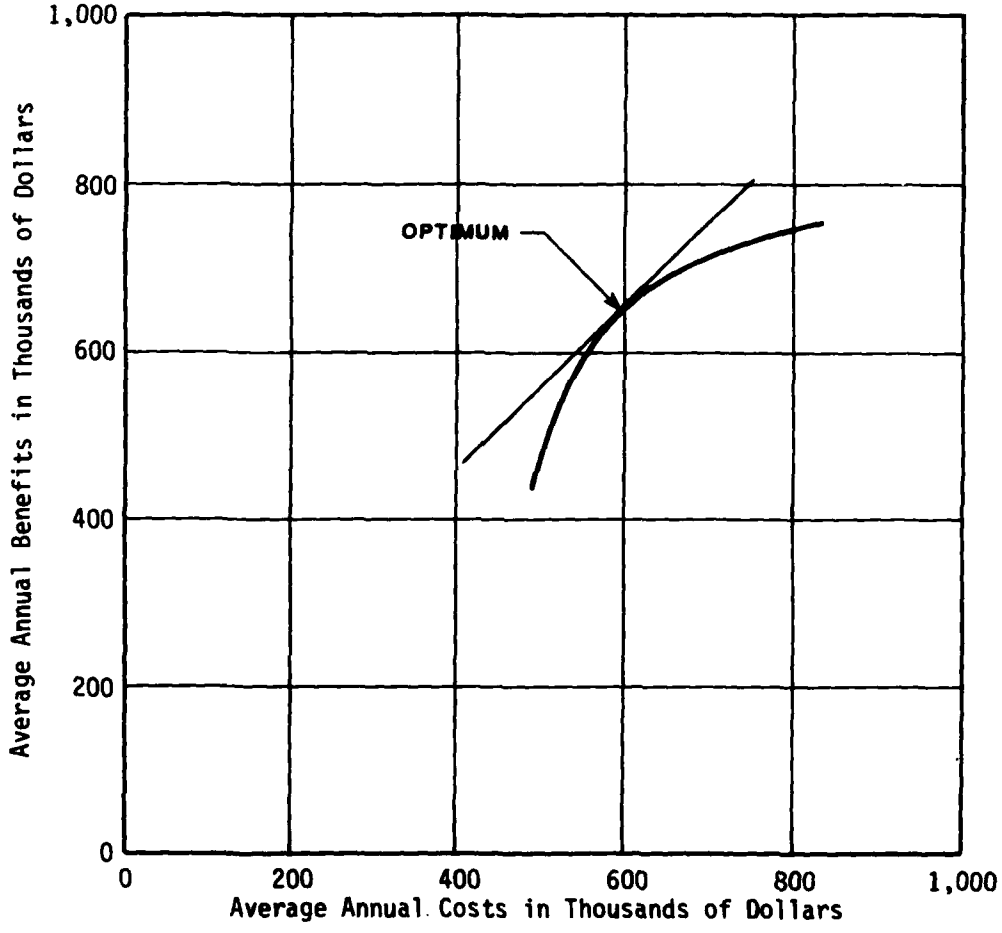
FLOOD STORAGE AND FLOOD PROOFING ALTERNATIVE

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/13 MARCH 1976

2

PLATE D-4



FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

MAXIMIZATION OF NET TANGIBLE BENEFITS

ST. PAUL, MINN. DISTRICT
FILE NO. M 35.1-R-5/14 MARCH 1976

PLATE D-5

SECTION E

THE SELECTED PLAN

THE SELECTED PLAN

Table of Contents

Item	Page
INTRODUCTION	E-1
PLAN DESCRIPTION	E-1
NONSTRUCTURAL FEATURES	E-1
GOLDEN VALLEY ROAD (COUNTY ROAD 66) TO DRESDEN LANE	E-1
NOBLE AVENUE TO HIGHWAY 100	E-2
PLYMOUTH CREEK UPSTREAM OF MEDICINE LAKE	E-2
NORTH BRANCH UPSTREAM OF LOUISIANA AVENUE NORTH	E-2
SWEENEY LAKE BRANCH.	E-2
STRUCTURAL FEATURES	E-3
MISSISSIPPI RIVER TO IRVING AVENUE NORTH	E-3
IRVING AVENUE NORTH TO GLENWOOD AVENUE	E-5
GLENWOOD AVENUE TO DRESDEN LANE	E-6
DRESDEN LANE TO UPSTREAM T.H. 100	E-7
UPSTREAM T.H. 100 TO MEDICINE LAKE	E-9
NORTH BRANCH FROM MEDICINE LAKE ROAD TO LOUISIANA AVENUE NORTH	E-10
AESTHETIC AND ENVIRONMENTAL CONSIDERATIONS	E-12
RECREATIONAL CONSIDERATIONS	E-12

Plates

Plate No.	
E-1	SELECTED PLAN
E-2	RECREATION FEATURES

SECTION E

SELECTED PLAN

This section describes in detail the plan selected to meet the water- and land-related resource needs of the Bassett Creek watershed. The description includes physical features, accomplishments and effects of the plan and significant design and construction information. Coordination was maintained with known interest groups to insure that the selected plan is socially acceptable. More detailed design information is presented in Section H of this appendix.

PLAN DESCRIPTION

The project would be designed to provide protection against a flood having a 1% chance of occurring in any one year (100-year frequency). Plate E-1 provides information on the locations, limits and types of flood control improvements proposed. Also included in the plan are recreational bikeways and hiking trails along some portions of the creek in Minneapolis. These recreational bikeways and hiking trails, as well as specific beautification measures will also be discussed in this section.

NONSTRUCTURAL FEATURES

As shown on Plate E-1, not all reaches of Bassett Creek are subject to structural protection by the selected plan. In those portions of the Bassett Creek watershed which would not be protected by the structural flood control features of the plan, nonstructural flood control measures are proposed.

GOLDEN VALLEY ROAD (COUNTY ROAD 66) TO DRESDEN LANE

The selected plan proposes flood proofing as a supplement to the base condition for this reach of Bassett Creek (Mile 4.51 to Mile 4.91). A total of three residences would be flood proofed along this reach. Flood

proofing of these three homes, as a supplement to the base condition, will prevent future flood damages resulting from a 100-year frequency flood.

NOBLE AVENUE TO UPSTREAM OF HIGHWAY 100

The selected plan proposed flood proofing as a supplement to the base condition in this reach (Mile 5.83 to Mile 6.44) of Bassett Creek. A total of sixteen homes would require flood proofing along this reach. Fifteen homes are located downstream of T.H. 100 and one home is located upstream of T.H. 100. The flood proofing of these sixteen residences, as a supplement to the base condition, will prevent future flood damages resulting from a 100-year frequency flood.

PLYMOUTH CREEK UPSTREAM OF MEDICINE LAKE

The selected plan proposes no action--maintain the base condition in this portion (Mile 1.98 to Mile 7.00) of the Bassett Creek watershed. There is no existing development within the 100-year flood plain along this reach, and flood plain regulation will prevent future flood damages.

NORTH BRANCH UPSTREAM OF LOUISIANA AVENUE NORTH

The selected plan proposed no action--maintain the base condition along this reach (Mile 1.52 to Mile 4.36) of the North Branch. There is no existing development within the 100-year flood plain along this reach of the North Branch, and flood plain regulation will prevent future damages.

SWEENEY LAKE BRANCH

The selected plan proposed no action--maintain the base condition along the Sweeney Lake Branch (Outlet to Mile 2.65). There is no existing development within the 100-year flood plain along the Sweeney Lake Branch, and flood plain regulation will prevent future flood damages.

STRUCTURAL FEATURES

The principal features of the selected plan involve the use of flood storage through the watershed and a new conduit in the outlet reach of Bassett Creek as shown on Plate E-1. To facilitate the discussion of the specific flood control features of the selected plan, the structural flood control features will be discussed for the various reaches of Bassett Creek.

MISSISSIPPI RIVER TO IRVING AVENUE NORTH Reach 1

The selected plan includes a new conduit in the reach from the Mississippi River to approximately the inlet of the existing conduit (Mile 1.52) along 2nd Avenue North. At the inlet to the proposed conduit, the 100-year flood discharge is 700 cubic feet per second at a flood level of 808.

The proposed conduit from the Mississippi River to the intersection of 3rd Avenue North and Washington Avenue North would be constructed in cooperation with the Minnesota Highway Department. The proposed new conduit outfalls into the Mississippi River in the pool downstream of the Upper St. Anthony Falls Lock and Dam. This reach of the proposed conduit would consist of an 11.0-foot diameter tunnel through the St. Peter Sandstone. The route of the proposed conduit would run diagonally from the outfall to the intersection of Portland Avenue and 2nd Street South, follow 2nd Street South and 2nd Street North to the intersection of 2nd Street North and 3rd Avenue North and then follow 3rd Avenue North to Washington Avenue North. This 4,800-foot portion of the proposed new conduit would be built solely by the Minnesota Highway Department (MHD) at a slightly increased size to carry highway storm water drainage as well as the Bassett Creek flood flows. The cost of this portion of the conduit would be shared based on peak flow rates.

The portion of the new conduit between the intersection of Washington Avenue North and 3rd Avenue North and approximately 11th Street North and Glenwood Avenue would be constructed in cooperation with the Minnesota

Highway Department. The route of this portion of the conduit lies within the right-of-way of the proposed Third Avenue highway distributor. The proposed Third Avenue distributor would provide a route connecting downtown Minneapolis to the Interstate highway system. The first cost of this cooperative conduit will be shared with the Minnesota Highway Department (MHD) based on peak flow rates. From Washington Avenue and 3rd Avenue North, approximately 850 feet along the 3rd Avenue distributor, this 8.0-foot diameter tunnel would be bored through the St. Peter Sandstone. From that point to approximately 11th Street North and Glenwood Avenue, a 2,300-foot portion of the conduit would be of open-cut construction following the excavation of the depressed highway gradeline. Along the open-cut portion of this route, an 8.5-foot diameter reinforced concrete pipe would be placed in the trench and backfilled.

From the intersection of approximately 11th Street North and Glenwood Avenue, the proposed conduit would follow Glenwood Avenue to the right-of-way of Interstate 94, would cross the right-of-way of Interstate 94 to 2nd Avenue North and would follow 2nd Avenue North to approximately the location of the existing conduit inlet near Dupont Avenue North. The entire cost of this portion of the proposed new conduit would be the burden of the proposed flood control project. This portion of the proposed conduit consists of 3,200 feet of 8.5-foot diameter tunnel or pipe. From approximately 11th Street North and Glenwood Avenue to a point just north and west of the right-of-way of the Burlington Northern railroad tracks, the proposed conduit would be of liner plate construction through approximately 800 feet of glacial drift. From the point north and west of the Burlington Northern railroad tracks to the inlet of the proposed conduit, the conduit would be of open-cut construction beneath Glenwood Avenue and 2nd Avenue North.

At the inlet to the proposed conduit, an inundation flood storage area would be excavated to provide approximately 90 acre-feet of flood storage (Mile 1.52 to Mile 1.85). This flood storage area would require approximately 20 acres of land along the south side of Bassett Creek between the inlet of the conduit and Irving Avenue North. A wetland pond area of approximately

10 acres would result from the excavation of this area. It is envisioned that this wetland pond would be developed as a Type 4 or Type 5 wetland under the Fish and Wildlife Services wetland classification. The normal water surface of this wetland pond would be at approximately Elevation 800 and have an average depth of about 1 foot. During periods of normal flow, Bassett Creek would flow through this wetland pond before entering the proposed conduit. The flood storage control structure would be located at the inlet to the proposed conduit. This flood storage control structure would consist of a drop-inlet structure and would include a trashrack to prevent debris from entering the proposed conduit. The remaining portions of the existing conduit would be abandoned following construction of the proposed flood storage area and conduit.

IRVING AVENUE NORTH TO GLENWOOD AVENUE Reach 2

In the reach of Bassett Creek from Irving Avenue North to a point upstream of Penn Avenue North (Mile 1.85 to Mile 2.45), the selected plan proposes approximately 3,000 feet of clearing and snagging to remove excessive natural and man-made debris from the channel and channel banks to improve the hydraulic efficiency of the channel. Trees in imminent danger of falling into the channel due to erosion of the root systems by flowing water would be removed. At locations where excessive brush impedes the flow of water, the brush would be thinned.

As part of the selected plan, it is proposed to repair and modify the upstream wing walls of the Cedar Lake Road bridge. The existing wing walls consist of sheet piling with tie-backs, portions of which are in a state of general disrepair. New concrete caps would be placed on the existing sheet piling and the tie-backs would be repaired. This repair and modification will improve the hydraulic efficiency of the entrance to the Cedar Lake Road bridge. In addition, repair will assure that these wing walls will not collapse during a flood event and restrict flow through the Cedar Lake Road bridge.

The selected plan proposed to remove the old Penn Avenue (Mile 2.35) crossing. This old box culvert crossing is not presently in use for vehicular traffic and a new bridge is being constructed across the creek valley at this same location. The removal of this old crossing and the subsequent landscaping in the immediate area will improve the hydraulic efficiency of this portion of the channel and result in flood level reductions upstream.

In this reach of Bassett Creek immediately downstream of Glenwood Avenue (Mile 2.61 to Mile 2.81), the selected plan proposes approximately 1,020 feet of flood wall along the left bank of the channel to protect industries located in this area and approximately 1,020 feet of retaining wall along the right bank. As part of the construction of these walls, the channel would be enlarged slightly through this reach to pass the required flood flows. These walls would replace the existing walls in the reach, which are in a state of general disrepair and of insufficient height to prevent flood damage from occurring to the industries located in the area. The existing low head rock dam in this reach would be replaced by a concrete ogee weir at the existing crest level.

Reach 3

GLENWOOD AVENUE TO DRESDEN LANE

The selected plan proposed increased flood storage on the Theodore Wirth Golf Course. The flood storage control structure for this storage site would be located immediately upstream of T.H. 55 (Mile 3.15) and would be located on highway right-of-way. This flood storage control structure would consist of a modification of the existing creek crossing. A pair of large diameter culverts to pass normal and 100-year flood flows and an overflow weir to pass the flood flows resulting from a storm of greater magnitude than the 100-year frequency storm would be installed at the entrance to the existing crossing. The proposed flood storage control structure would result in a 100-year flood level approximately 2 feet higher than the existing 100-year flood level in the Theodore Wirth Golf Course area.

Just upstream of T.H. 55 in Theodore Wirth Golf Course, a fork leaves the main channel to the east flowing under the railroad tracks and under

T.H. 55 to the east of the main channel crossing. Where T.H. 55 crosses this east fork of Bassett Creek, a new culvert would be installed under T.H. 55 as part of the selected plan. This new culvert will assure that local runoff will not cause flooding problems on the upstream side of T.H. 55 in this area.

The flood control structure along the main channel of Bassett Creek provides increased flood storage on Theodore Wirth Park which reduces the peak flood flows to downstream reaches. As a result of the decreased peak flood flows immediate downstream of T.H. 55, the proposed 100-year flood level on Wirth Lake would be approximately 1.5 feet lower than the existing 100-year flood level. The normal level of Wirth Lake and the normal flows in Bassett Creek would not be affected by the proposed project.

DRESDEN LANE TO UPSTREAM OF T.H. 100 REACH 4

As a part of the selected plan, approximately 300 feet of Dresden Lane (Mile 4.91) at the outlet of the Rice Lake area would be raised to maintain access to residences in the area during flood periods. This road raise would be approximately 2 feet and would prevent inundation of Dresden Lane as a result of a 100-year flood event.

The selected plan proposed flood storage on Rice Lake at approximately its existing 100-year flood level. At its existing 100-year flood level, the volume in the Rice Lake storage area would have to be increased by approximately 15 acre-feet. It is proposed to obtain this additional flood storage volume by relandscaping the area on the north end of the lake which has formerly been used for the disposal of demolition debris consisting of chunks of concrete, earth, wooden materials and other materials commonly found in building demolition debris. Following the relandscaping of this area, the selected plan proposes to cover this debris with a layer of earth followed by the spreading of black dirt, landscaping plantings and seeding to aesthetically enhance the area and improve its compatibility with the rest of the Rice Lake natural area.

The selected plan proposes new culvert crossings at both Noble Avenue (Mile 5.53) and Regent Avenue (Mile 5.83). These new crossings would

consist of larger culverts being placed at these channel crossings. Riprap would be required approximately 25 feet upstream of the inlets and approximately 50 feet downstream of the outlets at both of these new channel crossings in order to minimize potential erosion effects due to the high velocity flows through these culverts. At Minnaqua Avenue (Mile 5.94), the selected plan proposes the permanent removal of the Minnaqua Avenue bridge. A cul-de-sac would be constructed on Minnaqua Avenue on the east side of Bassett Creek, and the local residents would use one of several existing alternate routes to cross the creek instead of Minnaqua Avenue.

As part of the selected plan, about 1,800 feet of Toledo Avenue and West Bend Road (Mile 5.83 to Mile 5.94) would be raised approximately 3 feet. This road raise would prevent inundation of these streets and insure access to the homes in this area during flood periods.

Due to existing severe stream bank erosion immediately downstream of the existing culverts under T.H. 100, the selected plan proposes to riprap the channel banks approximately 200 feet downstream of this existing crossing to minimize future erosion problems.

Immediately upstream of T.H. 100 (Mile 6.46), the selected plan proposes a flood storage control structure consisting of an earth embankment with a large diameter culvert and overflow weir. The embankment for this proposed flood storage control structure has a total length of approximately 1,700 feet and extends about 1,200 feet northward from the centerline of the main stem at this location. The maximum height of this structure is 11 feet at the point where it crosses the channel. This flood storage control structure consists of a large diameter culvert to pass normal and 100-year flood flows and an overflow weir to pass flood flows resulting from storms of greater magnitude than the 100-year frequency storm. This flood storage control structure results in a proposed 100-year flood level approximately 3 feet above the existing 100-year flood level along the main stem upstream of the control structure. Approximately 800 feet of the channel immediately upstream of T.H. 100 would be cleared to remove natural debris and trees which are in imminent danger of falling into the creek and obstructing flood flows.

UPSTREAM T.H. 100 TO MEDICINE LAKE 12 REACH 5

The selected plan proposes a new channel crossing at Westbrook Road (Mile 7.01). The existing crossing at Westbrook Road has an insufficient discharge capacity to convey flood flows. The existing grade of Westbrook Road at the crossing would not be affected as a result of the new enlarged arch culverts, however, a portion of Westbrook Road would have to be removed to install the new culverts and would be replaced upon completion of construction.

At the downstream end of the Golden Valley Country Club golf course along the main stem, the selected plan proposes a flood storage control structure consisting of an earth embankment with a culvert and overflow weir outlet. This earth embankment is approximately 300 feet long and has a maximum height of 5 feet. The culvert through the embankment would pass normal flows and the overflow weir would pass the 100-year flood flow as well as flows resulting from storms of greater magnitude than the 100-year frequency storm. Flood storage on Golden Valley Country Club golf course would be at a 100-year flood level approximately 0.5 feet below the existing 100-year flood level. Flood storage upstream of this storage site reduces the peak flood flows entering the Golden Valley Country Club golf course area, however, the flood storage proposed on the golf course would further reduce the flood flows to downstream areas and prevent flood damages along the reach downstream.

A flood storage control structure is proposed in the selected plan upstream of Winnetka Avenue North (Mile 9.15). This flood storage control structure would consist of an earth embankment with culvert and overflow weir. The earth embankment is approximately 90 feet long and has a maximum height of 6 feet. The culverts through the embankment would pass normal channel flows as well as a portion of the 100-year flood flow while the overflow weir will pass the remainder of the 100-year flood flow as well as those flood flows resulting from storms of greater magnitude than the 100-year frequency storm.

The flood storage control structure upstream of Winnetka Avenue North results in increased flood storage along the channel between Winnetka Avenue and T.H. 55 as well as on the Brookview Community Golf Course. The proposed 100-year flood level along the channel upstream of Winnetka and on Brookview Community Golf Course would be approximately 1 foot above the existing 100-year flood level. As a result of the increased 100-year flood level upstream of Winnetka Avenue, about 800 feet of Boone Avenue north of T.H. 55, would be raised an average of 2 feet to prevent inundation as a result of a 100-year flood event.

A new outlet structure would be constructed for Medicine Lake and the existing structure would be removed. The new structure would consist of a 20 foot concrete overflow weir and a 360 foot overflow embankment. It would be located approximately 500 feet downstream of the existing outlet structure immediately upstream of the Minnesota Western Railway embankment (Mile 12.01). By relocating the structure, increased discharge capacity can be provided at flood stages without affecting normal spring high water levels. The proposed outlet structure would reduce the 100-year flood level on Medicine Lake approximately 0.5 foot below the existing 100-year flood level.

NORTH BRANCH FROM MEDICINE LAKE ROAD TO LOUISIANA AVENUE NORTH

The selected plan includes a proposed flood control structure upstream of T.H. 100 (Mile 6.46) on the main stem of Bassett Creek which will result in increased flood storage on Bassett Creek Park on the North Branch of Bassett Creek. The proposed 100-year flood level in Bassett Creek Park would be approximately 3 feet above the existing 100-year flood level. This increased flood level will result in the inundation of an additional 10 acres in the park as a result of the 100-year flood event. The proposed flood storage level in the park will not affect any of the existing active recreational facilities such as softball and baseball fields nor will it affect the picnic shelter and pavilion proposed by the City of Crystal on the higher ground of the park.

Enlarged culvert crossings are proposed in the selected plan for 32nd Avenue North (Mile 0.49), Brunswick Avenue and Adair Avenue (Mile 0.57) in order to prevent flood damage from occurring to residential properties upstream of these crossings. The selected plan also proposes to raise approximately 2,300 feet of 32nd, Brunswick and Adair Avenues slightly to prevent inundation and loss of access. These road raises would consist of a maximum road raise of about 3 feet. Some channel storage would be retained upstream of 32nd Avenue North at approximately the existing 100-year flood level as part of the selected plan.

A new culvert crossing is proposed at 34th Avenue North (Mile 0.80) as part of the selected plan. This new crossing would consist of an enlarged culvert under 34th Avenue North and would provide flood storage in the reach from upstream of 34th Avenue North to the upstream side of Douglas Drive. The enlarged channel crossing would provide flood storage upstream of 34th Avenue North at approximately its existing 100-year flood level. A new culvert crossing is proposed at Douglas Drive (Mile 0.99) where it crosses the North Branch of Bassett Creek, and Douglas Drive would be raised approximately 2 feet to prevent inundation as a result of a 100-year flood event.

The selected plan proposes a flood storage control structure between Douglas Drive and Florida Avenue North (Mile 1.05). This flood storage control structure would consist of an earth embankment with a culvert and an overflow weir. The earth embankment would be approximately 150 feet long and have a maximum height of approximately 18 feet. The culvert through the embankment would carry normal flows as well as the 100-year flood flow. The overflow weir would carry those flood flows resulting from storms of greater magnitude than the 100-year frequency storm. Upstream of this flood storage control structure, a flood storage area would be developed along the channel between the control structure and Louisiana Avenue North (Mile 1.52). The proposed 100-year level in this flood storage area would be approximately 4 feet below the existing 100-year flood level. In order to develop the required volume of storage at the required level to prevent flood damage, three residences between the control structure and Hampshire Avenue would have to be evacuated. Since one of these homes is currently owned by the City of Crystal as a result of a tax forfeiture,

the evacuation would require the relocation of two families. New culvert crossings would be required as part of the selected plan at Florida Avenue (Mile 1.12) and Hampshire Avenue (Mile 1.29). The Georgia Avenue (Mile 1.18) crossing would be removed as part of the proposed plan and a cul-de-sac would be constructed south of the creek, and local residents would have to use existing alternate routes to cross the creek. Between Hampshire Avenue North and Louisiana Avenue North, 1,100 feet of the creek channel would be enlarged to provide increased flood storage volume at the reduced flood level. This enlargement of the channel would be through the back-yards of the residences located on both sides of the channel and would result in the removal of several large willow trees along this reach.

AESTHETIC AND ENVIRONMENTAL CONSIDERATIONS

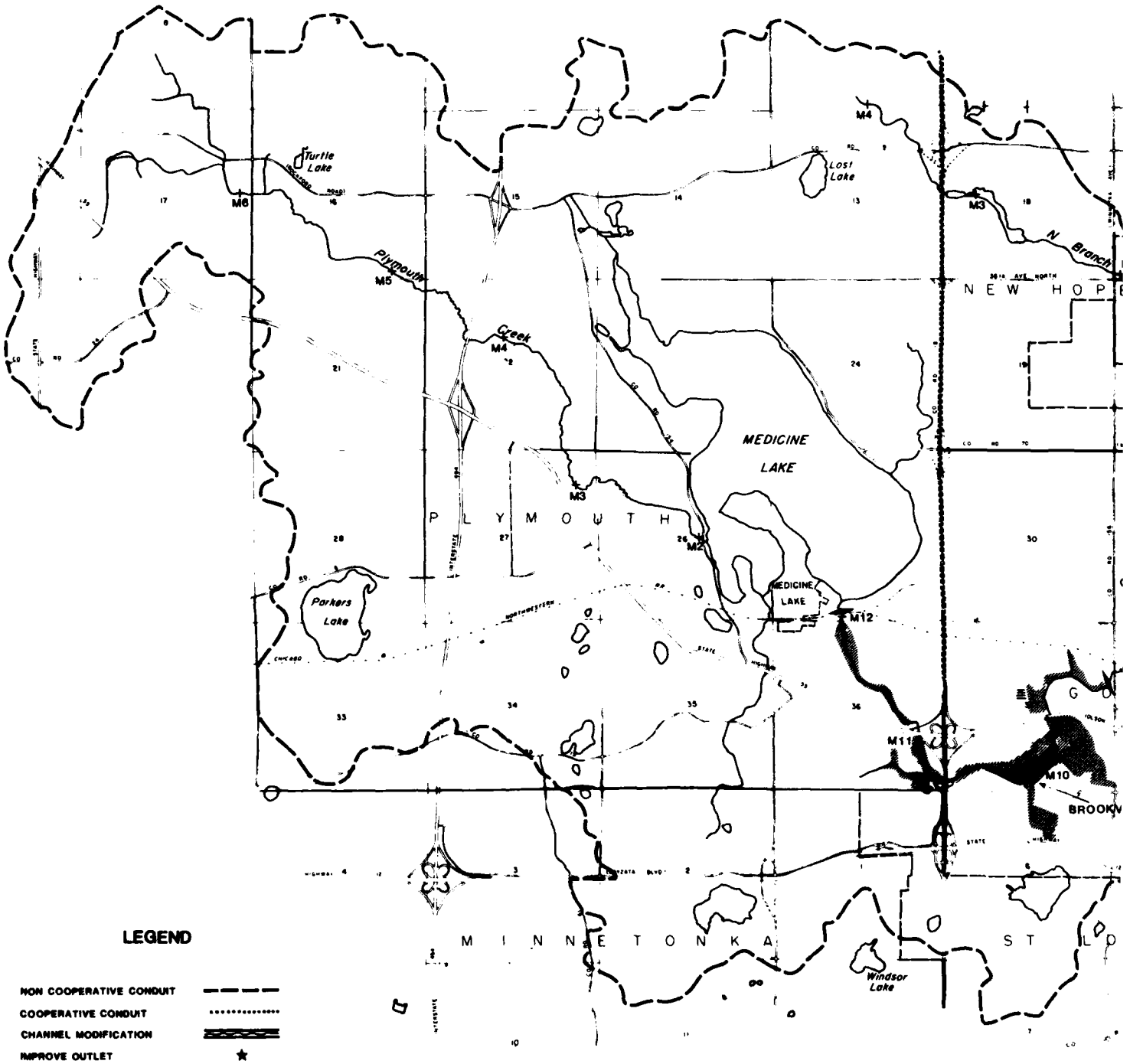
Since the early phases of this study, many citizens of the Bassett Creek watershed have expressed concern regarding the effects of proposed flood control plans on the aesthetic quality of the natural stream setting. In response to these concerns, beautification measures are proposed to minimize the adverse effects of structural measures on the aesthetic quality of the stream environment. These proposed beautification measures would consist of rustication of all visible concrete surfaces, landscaping of earth embankments to enhance their visual appearance and, at necessary locations, visual barriers consisting of wooden fences and/or shrubbery would be constructed to enhance the aesthetic qualities of the natural stream setting. During post-authorization studies, detailed archaeologic surveys and sampling programs would be conducted in accordance with the recommendations of the preliminary archaeological reconnaissance.

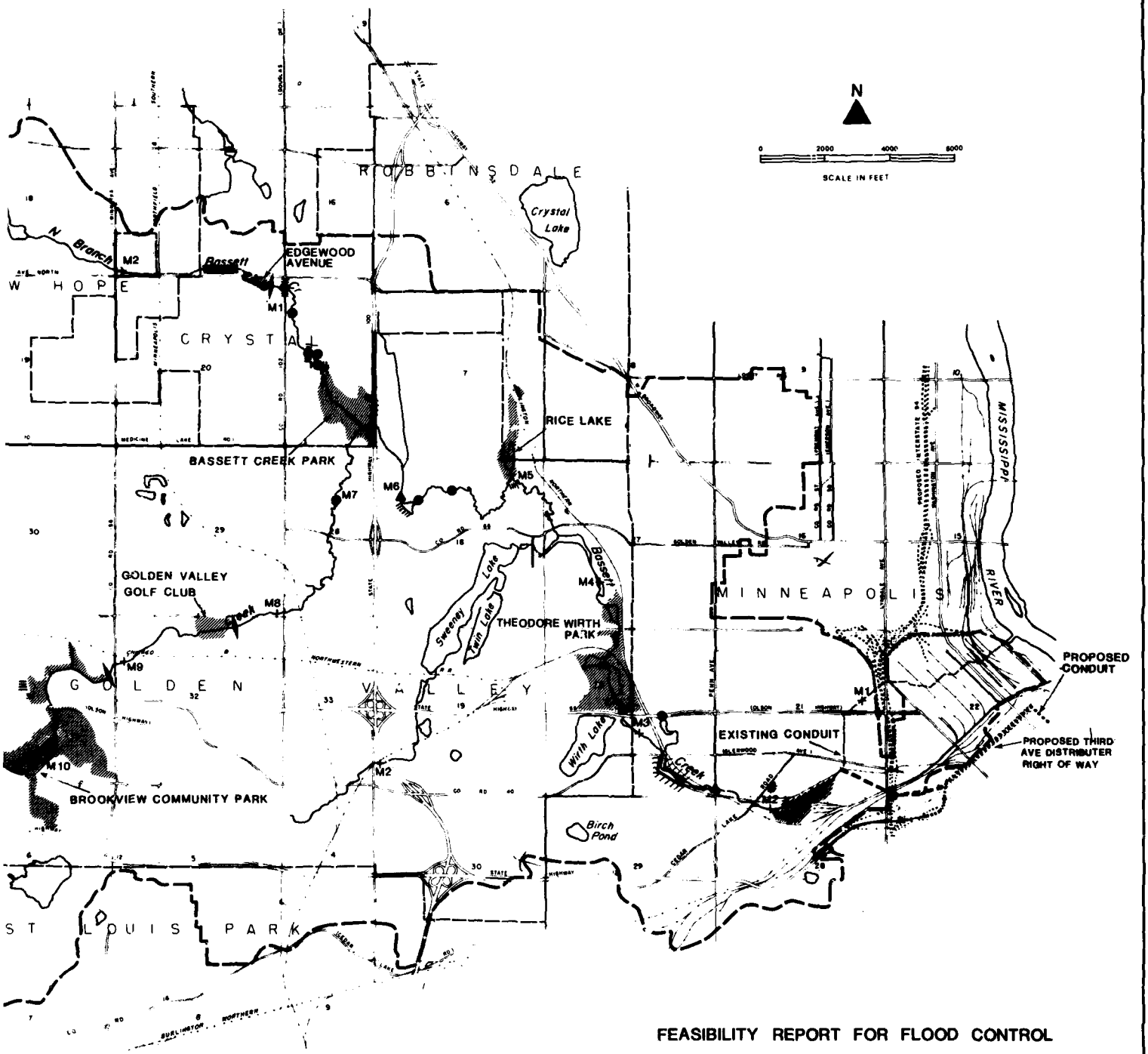
RECREATIONAL CONSIDERATIONS

In conjunction with the recommended flood control plan, recreation improvement measures would enhance portions of the project area. These measures include approximately 10,000 feet of bikeway and walk path along the creek corridor from the inlet of the proposed conduit to Glenwood Avenue and from the proposed flood storage area at the inlet of the conduit

to Bryn Mawr Meadows Park and would include a bridge over the Burlington Northern railroad tracks along the northern edge of Bryn Mawr Meadows Park.

It is proposed that access ramps be gently sloped and constructed of suitable material to permit use by elderly persons. Use of the bikeway or walk paths by motorized vehicles would be prohibited. The location and extent of the proposed bikeway and walk path system are shown on Plate E-2.


Turtle Lake
Lost Lake
M6
M4
M3
N Branch
Plymouth Creek
M5
M4
NEW HOP
MEDICINE LAKE
M3
PLYMOUTH
M2
Parkers Lake
MEDICINE LAKE
M12
M11
M10
BROOKV
MINNETONKA
ST L
Windsor Lake
LEGEND
NON COOPERATIVE CONDUIT
COOPERATIVE CONDUIT
CHANNEL MODIFICATION
IMPROVE OUTLET
EMBANKMENT WITH OUTLET
CHANNEL CROSSING - PIPE
CONTROL STRUCTURE
REMOVE CROSSING
RAISE ROAD
FLOOD WALL
STORAGE
MILES FROM MOUTH
M 10



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

SELECTED PLAN

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/15 MARCH 1976

2

PLATE E-1

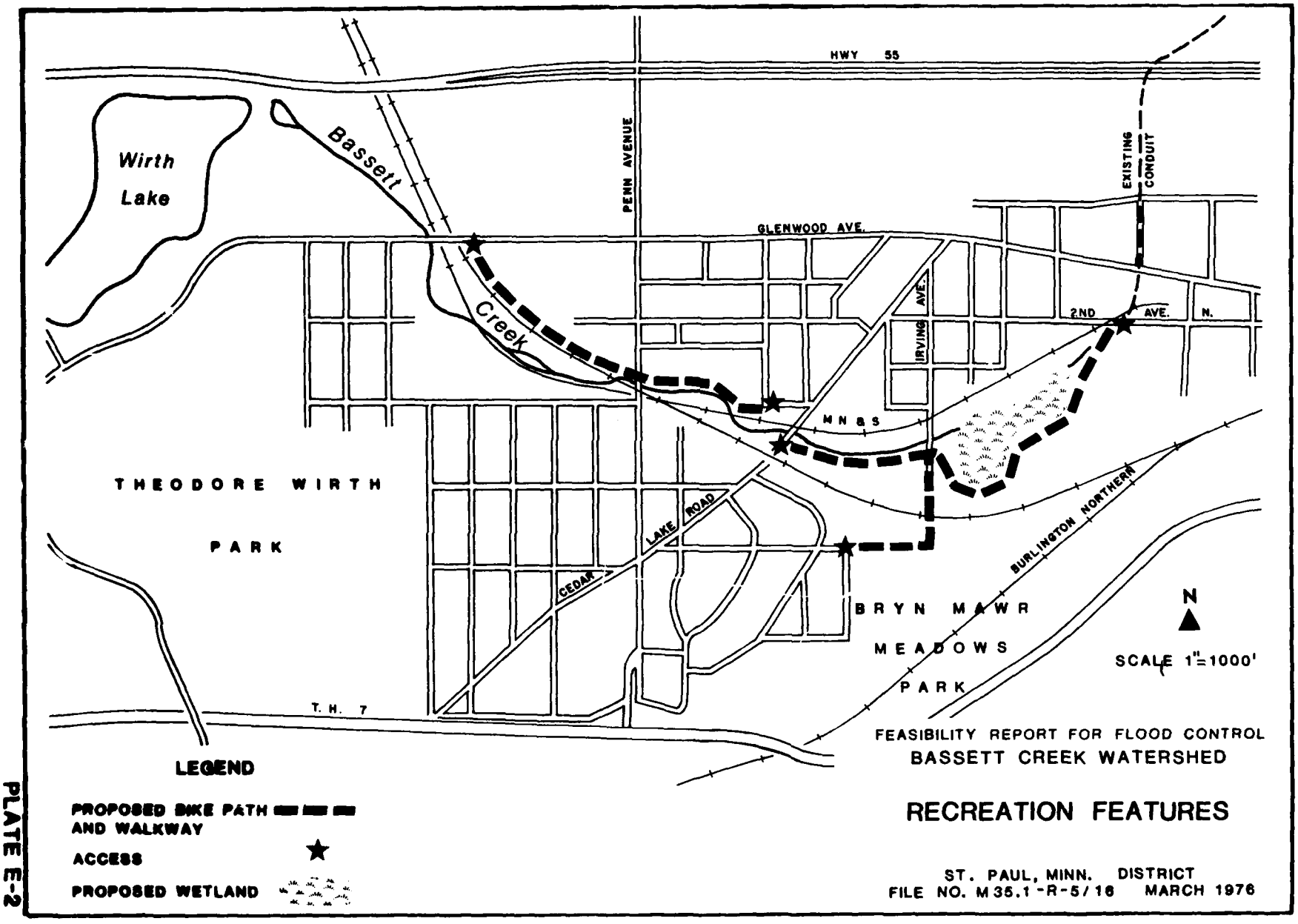

HWY 55
Wirth Lake
Bassett Creek
PENN AVENUE
EXISTING CONDUIT
GLENWOOD AVE.
IRVING AVE.
2ND AVE. N.
MN & S
THEODORE WIRTH PARK
LAKE ROAD
CEDAR
BURLINGTON NORTHERN
BRYN MAWR MEADOWS PARK
T. H. 7
N
SCALE 1"=1000'
LEGEND
PROPOSED BIKE PATH AND WALKWAY
ACCESS
PROPOSED WETLAND
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED
RECREATION FEATURES
ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/16 MARCH 1976

PLATE E-2

SECTION F

IMPACTS OF THE SELECTED PLAN

IMPACTS OF THE SELECTED PLAN

Table of Contents

Item	Page
INTRODUCTION	F-1
ECONOMIC IMPACTS OF FLOOD CONTROL	F-1
COSTS	F-1
FLOOD DAMAGE AND PROJECT BENEFITS	F-3
METHODOLOGY	F-3
FLOOD DAMAGE SURVEYS	F-3
TYPES OF FLOOD DAMAGES	F-4
Residential	F-4
Commercial and Industrial	F-4
Public	F-4
Transportation.	F-4
AREAS SUBJECT TO FLOODING	F-5
FLOOD DAMAGES--PRESENT CONDITIONS.	F-5
DERIVATION OF AVERAGE ANNUAL EQUIVALENT DAMAGES	F-5
Discharge-Frequency Relations.	F-5
Discharge-Damage Relations.	F-5
Damage-Frequency Relations.	F-5
Average Annual Damages	F-7
GROWTH OF PROJECTED FLOOD DAMAGES.	F-7
Growth to Existing Development	F-7
FLOOD CONTROL BENEFITS	F-9
ECONOMIC IMPACTS OF RECREATION	F-18
RECREATION CONSIDERATIONS	F-18
RECREATION DEMAND	F-18

Table of Contents (Continued)

Item	Page
CAPABILITY OF PROJECT IN MEETING DEMAND	F-19
ESTIMATED RECREATION BENEFITS	F-21
AVERAGE ANNUAL RECREATION BENEFITS	F-23
ADVANCE REPLACEMENT BENEFITS	F-23
REDEVELOPMENT BENEFITS	F-24
SUMMARY OF MONETARY BENEFITS	F-27
ECONOMIC JUSTIFICATION	F-27
IMPACTS ON THE NATURAL ENVIRONMENT	F-28
SOCIAL AND CULTURAL IMPACTS	F-34
RECREATION	F-34
HISTORICAL AND ARCHAEOLOGICAL	F-36
HUMAN ASPECTS	F-37
AESTHETIC ASPECTS	F-38

List of Tables

SUMMARY OF ESTIMATED FIRST COSTS	F-2
ESTIMATED ANNUAL COSTS	F-2
BASSETT CREEK WATERSHED--FLOOD DAMAGES EXISTING URBANIZATION	F-6
GROWTH COMPONENTS FOR COMMERCIAL-INDUSTRIAL UNITS	F-8
EXISTING AVERAGE ANNUAL FLOOD DAMAGES--EXISTING FLOOD LEVELS--EXISTING CHANNEL	F-10
ULTIMATE AVERAGE ANNUAL FLOOD DAMAGES--ULTIMATE FLOOD LEVELS--EXISTING CHANNEL	F-11
TOTAL AVERAGE ANNUAL DAMAGE	F-12
FLOOD DAMAGES AND PROJECT BENEFITS	F-13

List of Tables (Continued)

	Page
EXISTING AVERAGE ANNUAL PROJECT BENEFITS--WATERSHED PROTECTED FROM 100-YEAR FLOOD--EXISTING URBANIZATION. . . .	F-14
EXISTING AVERAGE ANNUAL PROJECT BENEFITS--WATERSHED PROTECTED FROM 100-YEAR FLOOD--ULTIMATE URBANIZATION. . . .	F-15
TOTAL AVERAGE ANNUAL BENEFITS	F-16
AVERAGE ANNUAL RESIDUAL DAMAGES	F-17
RECREATION PARTICIPATION.	F-20
VEHICULAR TRIPS THAT CAN BE ATTRACTED TO THE BICYCLE AS THE PRIMARY MODE.	F-20
EXPECTED PARTICIPATION RATES	F-21
TOTAL ANNUAL ACTIVITY OCCASIONS WITHIN ZONE OF INFLUENCE . . .	F-22
TOTAL ADJUSTED ANNUAL ACTIVITY OCCASIONS	F-23
REDEVELOPMENT BENEFITS	F-26
SUMMARY OF AVERAGE ANNUAL BENEFITS	F-27

Plates

Plate No.	
F-1	FLOOD DAMAGE RELATIONS

SECTION F

IMPACTS OF THE SELECTED PLAN

This section presents the expected economic impacts of the selected plan for a flood control project in the Bassett Creek watershed, over an assumed economic life of 100 years. Economic impacts include total and annual project costs and tangible flood control benefits, recreation benefits, advance replacement benefits and redevelopment benefits attributable to the proposed project. Environmental impacts include project effects on floral and faunal communities and on air and water quality. Social impacts include project-related effects on existing and projected communal patterns and on the general health and safety of affected study area residents.

ECONOMIC IMPACTS OF FLOOD CONTROL

The outstanding economic impact of the proposed project would be alleviation of $674,100 in average annual flood damages to business public property, and residential and other private property in the Bassett Creek watershed during the assumed economic life of 100 years. This estimate is based upon economic analysis described in detail in the following paragraphs.

COSTS

Detailed cost estimates for the selected plan in the Bassett Creek watershed are given in Section H. All costs are based on October, 1975 conditions and price levels and include appropriate allowances for contingencies, engineering and design, and supervision and administration. A summary of estimated first costs is given in Table 1.

TABLE 1

SUMMARY OF ESTIMATED FIRST COSTS[1]

Item	First Cost
Relocations	$ 1,349,000
Channels	5,150,000
Flood Walls	401,000
Recreation Facilities	154,000
Flood Control Structures	449,000
Lands, Right-of-Way, Easements	1,619,000
Engineering, Administration	1,018,000
TOTAL FIRST COSTS	$10,140,000

[1] October 1975 Price Levels

Estimated first costs are converted to average annual costs in Table 2 to facilitate comparison with related project benefits and arrive at the project benefit-cost ratio. Annual costs are based on a 6-1/8 percent interest rate and a 100-year economic life. Costs for subsequent operation and maintenance of the project are included in the annual costs. A detailed breakdown of the first cost is given in Section H of this appendix.

TABLE 2

ESTIMATED ANNUAL COSTS

Item	Average Annual Costs
Interest and Amortization	$623,000
Maintenance	10,000
TOTAL	$633,000

FLOOD DAMAGES AND PROJECT BENEFITS

METHODOLOGY

Average annual flood damages and benefits were evaluated for 1975 conditions and were projected to 1980, when it is assumed the project would be completed, by estimating interim economic growth. Flood damages will also increase with ultimate urbanization or future development of the 31% of the watershed that is currently undeveloped because runoff will increase and hydrologic conditions change. Due to the significant increase in flood discharge and flood levels in the watershed between existing urbanization and ultimate urbanization, damages and benefits were calculated for both these conditions. Discounted future damages and benefits were added to 1980 conditions to obtain average annual equivalent damages and benefits for the 100-year life of the project. Conservative projections of economic growth were made for the first 50 years of the assumed 100-year economic life of the project for commercial, industrial and public facilities and for the first 48 years for residential development. No growth was assumed for the remaining 50 and 52 years, respectively. The present worth of the difference between average annual damages and benefits for existing urbanization and ultimate urbanization was calculated assuming ultimate urbanization in 1995. The present worth of the annual average damages and benefits with ultimate urbanization were added to 1980 existing urbanization average annual damages and benefits to obtain average annual damages and benefits for the life of the project.

FLOOD DAMAGE SURVEYS

Flood damage surveys of the Bassett Creek watershed were made between 1970 and 1975. Hypothetical flood damages were obtained for the 10-year, 50-year and 100-year floods with existing urbanization and with ultimate urbanization. These surveys indicate 19 businesses and 222 residences would be damaged by the 100-year flood.

TYPES OF FLOOD DAMAGES

Flood losses in the Bassett Creek watershed include physical damage caused by inundation, business losses due to decreased production, loss of profits and wages and increased cost of normal operation and living. Additional losses are incurred in flood fighting and flood preparation, but due to the short time of peak and short duration of the flood waters, these losses are small. Damages were obtained for the following categories:

Residential

Residential damages include inundation losses to all residences and upper tenant structures, including building contents and damage to grounds.

Commercial and Industrial

Damages include physical losses to properties and facilities used for retail and wholesale trade, services, manufacturing, and warehousing. Wage and profit losses and increased cost of normal operations resulting from evacuation and cleanup are also included.

Public

Damages include all costs associated with physical flood losses to public property such as municipal buildings, sewage, water and park systems. Other losses to the public include additional costs incurred during flood emergencies such as evacuation; flood fighting; disaster relief; and extra duty for police, fire and martial units.

Transportation

Transportation damages consist of the cost of additional mileage required because of inundated roadways and the resulting detours required.

AREA SUBJECT TO FLOODING

The areas subject to frequent flooding include residential areas in the upper watershed and the industrial and commercial lands in the lower watershed. Parks, golf courses and other recreation areas are also subject to frequent flooding throughout the watershed. The larger floods will inundate residential areas near the conduit entrance, in addition to the industrial and commercial areas, and several major highways and railroads throughout the watershed will also be inundated. Flood prone areas of the Bassett Creek watershed are shown on Plate H-25.

FLOOD DAMAGES - PRESENT CONDITIONS

Flood damages in the Bassett Creek watershed were evaluated for three hypothetical flood events: (1) 10-year flood; (2) 50-year flood; (3) 100-year flood with existing urbanization and with ultimate urbanization of the watershed. Flood damages that could be expected from these floods are shown in Table 3.

DERIVATION OF AVERAGE ANNUAL EQUIVALENT DAMAGE

Average annual damages were derived as follows:

Discharge - Frequency Relations - Curves showing discharge frequency were developed for 11 reaches of the Bassett Creek watershed.

Discharge - Damage Relations - A discharge-damage curve was constructed for each of the 11 reaches by plotting the damages for the 10-year, 50-year, 100-year flood discharge, for existing and ultimate urbanization of the watershed.

Damage - Frequency Relations - The discharge-frequency and discharge-damage curves were used to construct damage-frequency curves. The area under these curves when converted to dollars is the average annual flood damage. Plate F-1 shows one of the discharge-frequency-damage relations

TABLE 3
BASSETT CREEK WATERSHED - FLOOD DAMAGES
EXISTING URBANIZATION

Reach	10-Year Flood			50-Year Flood			100-Year Flood			Standard Project Flood		
	Industrial	Residential	Public	Industrial	Residential	Public	Industrial	Residential	Public	Industrial	Residential	Public
Main Branch												
Conduit-Entrance												
Highway 100	$632,600	$125,700	$81,100	$1,382,700	$269,600	$364,000	$1,669,200	$ 523,900	$436,600	$9,069,300	$3,488,200	$1,395,300
Highway 100 - Medicine Lake	--	62,300	13,900	--	83,200	16,400	--	206,400	267,500	53,000	267,000	285,000
Around Medicine Lake	--	5,900	--	--	10,400	--	--	23,400	--	--	175,000	--
North Branch												
32nd Avenue - M.N. & S.R.R.	--	215,900	2,100	--	242,900	2,900	--	408,700	3,700	--	509,000	5,000
TOTAL	$632,600	$409,800	$97,100	$1,382,700	$606,100	$383,300	$1,669,200	$1,162,500	$707,800	$9,122,300	$4,439,200	$1,685,300

developed for the reach between Penn Avenue and the conduit entrance with and without the proposed project.

Average Annual Damages - The area under the damage-frequency curves for existing and ultimate development when changed to an equivalent dollar value is the average annual damage for October, 1975 conditions. Existing average annual flood damages for the Bassett Creek watershed are $493,900 and average annual damages for ultimate development are $648,100.

GROWTH OF PROJECTED FLOOD DAMAGES

Increase in flood damages due to future growth has been based upon expected increases in damages to residential contents, public facilities and utilities, and industrial and commercial establishments. No increase in flood damages due to new structures is expected as existing flood plain regulations require new structures to be built above the elevation of the 100-year flood.

Growth to Existing Development

The per capita income index for the Minneapolis-St. Paul SMSA was used as the growth index for the contents of residential structures. The growth to the contents damage of residential structures was limited to 75% of the value of the structures. OBERS projections indicate per capita income will increase at an annual rate of approximately 2.3% between 1980 and 2030. Using this growth rate for residential contents, the maximum damage to contents would occur in 48 years. No growth was assumed for the remainder of the 100-year economic life of the project.

Future increases in industrial and commercial damages were projected independently for each business enterprise. A personal interview was conducted with each firm in order to jointly determine which existing condition damage source will change in the future. Past patterns of internal growth within the firm and the firm's visibile growth horizon

were discussed. Based upon these discussions, realistic decisions were made concerning plant production capacities, inventory and/or stock material growth, production equipment improvements, sources of profit growth and changes in labor inputs (loss of wages). Rates of change and timing of changes for damages sustained were uniquely determined for each firm studied. Some near term increase in damages was also recognized based upon pending installation of pollution control devices and facilities currently required by government regulatory agencies for specific industries. These improvements will be subject to flood damages. Because of the limited number of businesses sustaining damage and the possibility for unauthorized disclosure, a table of individual company damage projections is not included. However, the percent of damages subject to future increase and the percent determined to remain constant over the project life is presented in Table 4.

TABLE 4

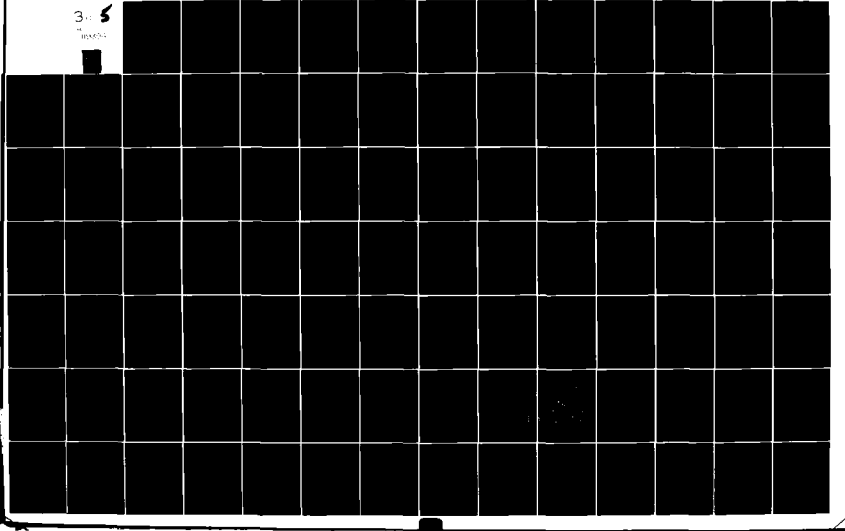
GROWTH COMPONENTS FOR COMMERCIAL-INDUSTRIAL UNITS

Type of Damage	Firm A	B	C	D	E	F	G
Constant	82%	90%	94%	56%	96%	100%	100%
Subject to Growth	8%	10%	6%	44%	4%	0%	0%

Individual company projected damages were summed and an index of change over time determined. Average annual commercial and industrial damages shown in Table 5 displays anticipated changes for the first years of project life. Very little growth after the year 2000 is reasonably projected using this direct interview and study method because change beyond the year 2000 is very difficult industry to anticipate. No growth was assumed for the remainder of the 100-year project life.

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Existing public damages are also expected to increase as public facilities and service systems are upgraded. The increase in public damages between 1980 and 2030 was estimated by the projected increase in population of the Bassett Creek watershed for the same time period. No growth was assumed for the remaining 50 years of the 100-year economic life of the project.

Tables 5 and 6 show the increase in average annual flood damages due to growth of existing development. The total increase in annual average flood damages resulting from growth to existing development between 1980 and 2030 is $257,100 and $374,600 for floods with existing development and ultimate development, respectively. Table 7 shows that due to increased runoff caused by ultimate urbanization or future development in the watershed, the present worth of the average annual increase in damages is $155,900 and that the total average annual damages are $767,900.

FLOOD CONTROL BENEFITS

Benefits from flood damage reduction were evaluated as the difference in flood damages with and without the project. Average annual benefits were calculated by subtracting average annual damages with the project from average annual damages without the project for both existing and ultimate development conditions. Table 8 shows average annual project benefits by reach with existing conditions.

The increase in flood damages in the absence of a project results in an increase in benefits from those calculated for 1980 conditions. Rates used to estimate the growth in project benefits are the same as used for increasing flood damages. Tables 9 and 10 show the increase in average annual benefits for the selected plan for existing development and ultimate development of the watershed. The average annual flood control benefits over the assumed 100-year economic life of the project, as shown on Table 11, are $674,100.

TABLE 5
EXISTING AVERAGE ANNUAL FLOOD DAMAGES - BASSETT CREEK WATERSHED
EXISTING FLOOD LEVELS
EXISTING CHANNEL

Type of Damage	1975	1980	1990	Year 2000	2010	2020	2030	Increase 1980-2030	Average Annual Equivalent of Increase Over 100-Year Project Life	Total Average Annual Damages
Residential	$171,300	$182,900	$203,400	$229,000	$261,300	$301,700	$343,100	$160,200	$46,500[1]	$229,400
Commercial-Industrial	273,000	281,200	316,700	352,200	357,600	360,400	365,800	84,600	45,000[2]	326,200
Municipal	46,800	49,600	52,900	56,600	59,400	61,300	61,800	12,200	4,000[3]	53,600
Transportation	2,800	2,800	2,800	2,800	2,800	2,800	2,800	0	0	2,800
Total Damages	493,900	516,500	575,800	640,600	681,100	726,200	773,500	257,000	95,500	612,000

[1] Compound growth of contents for 48 years and no growth for last 52 years of 100-year economic life at 6-1/8 percent = .29055

[2] Straight-line growth for the periods 1980 to 2000 and 2000 to 2030 with no growth for the last 50 years of 100-year economic life at 6-1/8 percent = .5315

[3] Straight-line growth for 50 years and no growth for last 50 years of 100-year economic life at 6-1/8 percent = .32703

TABLE 6
ULTIMATE AVERAGE ANNUAL FLOOD DAMAGES - BASSETT CREEK WATERSHED
ULTIMATE FLOOD LEVELS
EXISTING CHANNEL

Type of Damage	1975	1980	1990	Year 2000	2010	2020	2030	Increase 1980-2030	Average Annual Equivalent of Increase Over 100-Year Project Life	Total Average Annual Damages
Residential	$282,900	$331,000	$365,000	$407,600	$461,200	$ 528,600	$ 569,000	$265,000	$ 77,000[1]	$408,000
Commercial-Industrial	311,400	320,700	361,200	401,700	407,900	411,000	417,300	96,600	51,300[2]	372,000
Municipal	50,100	53,100	56,600	60,600	63,600	65,600	66,100	13,000	4,300[2]	57,400
Transportation	3,700	3,700	3,700	3,700	3,700	3,700	3,700	0	0	3,700
Total Damages	648,100	708,500	786,500	873,600	936,400	1,008,900	1,083,100	374,600	132,600	841,100

[1]Compound growth of contents for 48 years and no growth for last 52 years of 100-year economic life at 6-1/8 percent = .29055

[2]Straight-line growth for the periods 1980 to 2000 and 2000 to 2030 with no growth for the last 50 years of 100-year economic life at 6-1/8 percent = .5315

[3]Straight-line growth for 50 years and no growth for last 50 years of 100-year economic life at 6-1/8 percent = .32703

TABLE 7

TOTAL AVERAGE ANNUAL DAMAGES

Average annual damages	ultimate flood levels	$841,100
Average annual damages	existing flood levels	612,000
	Increase	229,100
Average annual equivalent factor[1]		.6807
Present worth of increase		155,900
Average annual damages	existing flood levels	612,000
	Total average annual damages	767,900

[1]Straight-line growth for 15 years at 6-1/8 percent.

TABLE 8

FLOOD DAMAGES AND PROJECT BENEFITS

Reach	Existing Average Annual Damages	Average Annual Damages With Project	Project Benefits
Main Stem			
Conduit to T.H. 100	$375,120	$40,980	$334,140
Highway 100 to Medicine Lake	23,200	3,100	20,100
Medicine Lake	2,030	320	1,710
North Branch			
32nd Avenue to M.N. & S.R.R.	91,550	5,200	86,350
Sweeney Lake Branch			
Transportation	2,000	2,000	0
TOTAL	493,900	51,600	442,300

TABLE 9
EXISTING AVERAGE ANNUAL PROJECT BENEFITS
WATERSHED PROTECTED FROM 100-YEAR FLOOD EXISTING URBANIZATION

Type of Damage	1975	1980	1990	Year 2000	2010	2020	2030	Increase 1980-2030	Average Annual Equivalent of Increase Over 100-Year Project Life	Total Average Annual Benefits
Residential	$156,600	$167,300	$186,100	$209,800	$239,500	$276,800	$314,100	$146,800	$42,700[1]	$210,000
Commercial-Industrial	252,100	259,700	292,400	325,200	330,300	332,80	337,800	78,100	41,500[2]	301,200
Municipal	40,900	43,400	46,200	49,500	51,900	53,600	54,000	10,600	3,500[3]	46,900
Transportation	2,800	2,800	2,800	2,800	2,800	2,800	2,800	0	0	2,800
Total Damages	452,400	473,200	527,500	587,300	624,500	666,000	708,700	235,500	87,700	580,900
Less Areas Not Protected	10,100	10,600	11,200	11,800	12,300	12,600	12,700	2,100	700[3]	11,300
Total Benefits	442,300	462,600	516,300	575,500	612,200	653,400	696,000	233,400	87,000	549,600

[1]Compound growth of contents for 48 years and no growth for last 52 years of 100-year economic life at 6-1/8 percent interest = .29055

[2]Straight-line growth for the periods 1980 to 2000 and 2000 to 2030 with no growth for the last 50 years of 100-year economic life at 6-1/8 percent = .5315.

[3]Straight-line growth for 50 years and no growth for last 50 years of 100-year economic life at 6-1/8 percent = .32703

TABLE 10
EXISTING AVERAGE ANNUAL PROJECT BENEFITS
WATERSHED PROTECTED FROM 100-YEAR FLOOD - ULTIMATE URBANIZATION

Type of Damage	1975	1980	1990	Year 2000	2010	2020	2030	Increase 1980-2030	Average Annual Equivalent of Increase Over 100-Year Project Life	Total Average Annual Benefits
Residential	$264,500	$283,500	$314,200	$354,100	$404,200	$467,100	$503,100	$220,600	$64,100[1]	$346,600
Commercial-Industrial	289,800	298,500	336,200	373,800	379,600	382,500	388,300	89,800	47,700[2]	346,200
Municipal	44,100	46,700	49,800	53,400	56,000	57,800	58,200	11,500	3,800[3]	50,500
Transportation	3,600	3,600	3,600	3,600	3,600	3,600	3,600	0	0	3,600
Total Damages	602,000	631,300	703,800	784,900	843,400	911,000	953,200	321,900	115,600	746,900
Less Areas Not Protected	12,900	13,500	14,300	15,100	15,700	16,100	16,200	2,700	900[3]	14,400
Total Benefits	589,100	617,800	689,500	769,800	827,700	894,900	937,000	319,200	114,700	732,500

[1]Compound growth of contents for 48 years and no growth for last 52 years of 100-year economic life at 6-1/8 percent interest = .29055

[2]Straight-line growth for the periods 1980 to 2000 and 2000 to 2030 with no growth for the last 50 years of 100-year economic life at 6-1/8 percent = .5315

[3]Straight-line growth for 50 years and no growth for last 50 years of 100-year economic life at 6-1/8 percent interest = .32703.

TABLE 11

TOTAL AVERAGE ANNUAL BENEFITS

Average Annual Benefits	Ultimate Development	$732,500
Average Annual Benefits	Existing Development	549,600
	Increase	182,900
Average Annual Equivalent Factor[1]		.6807
Present Worth of Increase		124,500
Average Annual Benefits	Existing Development	549,600
	Total Average Annual Benefits	674,100

[1]Straight-line growth for 15 years at 6-1/8 percent.

TABLE 12
AVERAGE ANNUAL RESIDUAL DAMAGES
BASSETT CREEK WATERSHED

	Year							
	1975	1980	1990	2000	2010	2020	2030	Total Average Annual
Total Damages - Without Project	$598,900	$647,200	$719,200	$799,200	$854,900	$918,600	$984,200	$767,900
Total Benefits - With Project	542,200	568,200	634,200	707,800	758,900	817,800	860,000	674,100
Total Residual Damages - With Project	56,700	79,000	85,000	91,400	96,000	100,800	124,200	93,800

ECONOMIC IMPACTS OF RECREATION

RECREATION CONSIDERATIONS

Certain recreation facilities could be provided with the Bassett Creek Flood Control Project. An example of such facilities would be the development of a natural area around the pond within the inundation storage area at the existing conduit inlet. The development of a bicycle and walking path from Glenwood Avenue near Theodore Wirth Park to 2nd Avenue North near the existing conduit inlet and from the proposed inundation area to Bryn Mawr Park would provide additional recreational opportunities. The trail would be approximately 1.9 miles long bordering Bassett Creek for most of its length. The location and extent of these facilities are show on Plate E-2.

RECREATION DEMAND

Bicycling has grown rapidly in the metropolitan area in the past few years. Similarly, other forms of recreation such as fishing, hiking, pleasure walks, and bird watching have all experienced increases. Reasons most often cited for the increased popularity of those latter activities include:

a. An increased interest in and concern about our environment and man's effects on it.

b. They are relatively inexpensive activities to participate in.

c. The relative ease to become proficient at the activities.

d. The activities provide enjoyment for all ages.

e. Usually no user fees are charged.

f. These recreational pursuits allow the observation of nature in an urban environment.

CAPABILITY OF PROJECT IN MEETING DEMAND

The recreational demands in the Bassett Creek watershed for bicycling, hiking, and nature oriented activities appear to be sufficient to warrant the development of a 1.9 mile biking and hiking trail and 20-acre natural area. Because of interest by the Minneapolis Task Force on Bassett Creek in developing a system of walking, bicycling, and cross-country ski trails, use of the creek corridor is expected to increase. The Minnesota Department of Natural Resources, Division of Parks and Recreation is administering a Bicycle Assistance Program where monies appropriated by the Legislature (Laws of Minnesota, Chapter 648, Section 3, Subdivision 6) are used to reimburse local communities on a 65-35 grant-in-aid basis, with the government assuming 35 percent of the cost. Of the 23 grants awarded, 17 were in the seven-county metropolitan area. Coordination of the biking and hiking trail in the proposed action with existing, as well as planned trails by cities within the watershed as well as the state, will aid in satisfying the growing demand for these facilities. According to the Minnesota Department of Natural Resources' State Comprehensive Outdoor Recreation Plan (SCORP, 1974), adult bicycling participation will almost double by 1980. Minneapolis Park Board personnel have indicated that, due to the increasing number of bicycles and the need for safety in bikeway and walkway facilities, separated facilities are warranted. According to a Minneapolis bicycle licensing official, 200,000 bicycles are present in the City of Minneapolis, and this number is increasing annually. Although participation statistics are scarce for local areas and non-existent for the Bassett Creek watershed as a unit, the bicycling participation rates in the metropolitan area are expected to be greater than estimated state bicycling rates due to population distribution. The following Table 13 summarizes projected bicycle participation on a statewide level:

TABLE 13

RECREATION PARTICIPATION

Participation Per Capita	1975	1980	1990
Adults (20 years and over)	11.8	18.9	25.8
Sub-Adults (6-19 years)	113.3	116.0	121.4

Source: Minnesota State Comprehensive Outdoor Recreation Plan - 1974

The greatest need for bicycle trails exist where population centers are located and the only biking routes available are existing streets and highways which are often unsafe and unenjoyable due to heavy urban traffic. Table 14 illustrates potential use of the bicycle for purposes other than recreation with proper facilities, although the potential benefits of these additional activities were not considered.

TABLE 14

VEHICULAR TRIPS THAT CAN BE ATTRACTED TO THE BICYCLE AS THE PRIMARY MODE

TWIN CITIES METROPOLITAN AREA

Trip Purpose	Number of Daily Vehicular Trips That Take Six Minutes or Less to Complete	Percent of Daily Trips Six Minutes or Less in Duration That Can be Made by Bicycle	Number of Daily Vehicular Trips That Would be Attracted to Bicycle Use if Proper Facilities Were Provided
School	32,249	50%	16,124
Personal Business	269,560	30%	80,868
Shopping	274,983	20%	54,997
Work	156,736	5%	7,837
Medical	6,708	5%	335
TOTAL			162,161

Source: Estimating Potential Bicycle Use and Public Investment Barton-Aschman Association, Inc., August, 1973.

ESTIMATED RECREATION BENEFITS

Expected participation rates for various activites for years 1980, 2000, and 2020 are given in Table 15.

TABLE 15
EXPECTED PARTICIPATION RATES[1]

	Year 1980	2000	2020
Bicycling	6.00	6.48	6.97
Nature walks	1.00	1.08	1.13
Walking for pleasure	6.79	7.64	8.60
Bird watching	1.10	1.19	1.28
Hiking	0.49	0.61	0.78
Fishing	3.79	3.75	3.65

[1]Bureau of Outdoor Recreation, "West North Central Participation Rates for 1969".

Total annual activity occasions for these various recreational activities within the Bassett Creek watershed were computed by applying the participation rates in Table 15 to population projections in the Minneapolis portion of the watershed, even though the zone of influence could be expected to be much larger. Table 16 summarizes projected annual activity occasions.

Not all activity occasions given in Table 15 would be directly attributable to the project. Adjusted annual activity occasions for years 1980, 2000, and 2020 are shown in Table 17 along with a percent effects column reflecting that portion of total activity occasions expected to occur with the trail system and natural area proposal.

TABLE 16

TOTAL ANNUAL ACTIVITY OCCASIONS WITHIN ZONE OF INFLUENCE

Activity	1980 Population 25,600[1] Participation Rate[3]	1980 Total Annual Activity Occasions[2]	2000 Population 26,800[1] Participation Rate[3]	2000 Total Annual Activity Occasions[2]	2020 Population 26,000[1] Participation Rate[3]	2020 Total Annual Activity Occasions[2]
Bicycling	6.00	153,600	6.48	173,664	6.97	181,200
Walking for pleasure	6.79	173,824	7.64	204,752	8.60	223,600
Bird watching	1.10	28,160	1.19	31,892	1.28	33,280
Hiking	0.49	12,544	0.61	16,348	0.78	20,280
Fishing	3.79	97,024	3.75	100,500	3.65	94,900
Nature Walks	1.00	25,600	1.08	28,944	1.13	29,380
TOTAL		490,752		556,100		582,660

[1]Projections based on Metropolitan Council data.

[2]Total annual activity occasions; participation rates x population.

[3]Bureau of Outdoor Recreation "West Central Participation Rates for 1969".

TABLE 17

TOTAL ADJUSTED ANNUAL ACTIVITY OCCASIONS

Activity	Percent Effective	1980	2000	2020
Bicycling	25	38,400	43,416	45,305
Walks for pleasure	20	34,765	40,950	44,720
Bird watching	10	2,816	3,189	3,328
Hiking	20	250	3,270	4,056
Fishing	10	9,702	10,050	9,490
Nature walks	10	2,560	2,894	2,938
Activity occasions		88,493	103,769	109,837
Recreation days[1]		35,397	41,507	43,935

[1]Recreation day = 2.5 activity occasions.

AVERAGE ANNUAL RECREATION BENEFITS

Standard economic discounting procedures were utilized to convert annual recreation days to average annual recreation days. The average unit user-day value for the recreation activites included in this analysis was assumed to be $0.75 per recreation day in the interest of a conservative estimate. Average annual benefits attributable to the $37,500 average annual recreation days would, therefore, be $28,100.

ADVANCE REPLACEMENT BENEFITS

The estimated costs of a complete repair of the existing conduit would be $5,788,700 based on October, 1975 construction costs. Construction of the proposed conduit would obviate the need for repairing the existing conduit. Accordingly, average annual costs of repair are considered to be a benefit attributable to the project. These costs are estimated to be $145,200 based on interest and amortization computed at 6-1/8% over an assumed economic life of 100 years and assuming repair work would have to be completed by 1995 in order for the existing conduit to remain functional.

The estimated replacement cost for the existing flood walls downstream of Glenwood Avenue would be $369,900 based on October 1975 construction costs. Construction of the proposed flood walls would obviate the need for replacement of the existing flood walls. Accordingly, average annual costs of replacement are considered to be a benefit attributable to the project. These costs are estimated to be $16,900 based on interest and amortization computed at 6-1/8% over an assumed economic life of 100 years and assuming the replacement work would have to be completed by 1985.

Total advance replacement benefits attributable to the project are estimated to be $162,100.

REDEVELOPMENT BENEFITS

GENERAL

In accordance with the Water Resources Council's Principles and Standards (38FR174), in areas having persistent unemployment or underemployment, project benefits shall be increased by the value of labor and other resources required for project construction. Since parts of the area within commuting distance of the project have been designated as areas of persistent unemployment, redevelopment benefits are to be evaluated and project benefits increased by that amount.

METHODOLOGY AND ASSUMPTIONS

The recommended plan will have an effect upon the local economy. The initial investment will create new jobs and income flows, thereby directly reducing unemployment and underemployment. There will be demands for both labor and construction materials required for project construction and incomes of individuals in associated industries will be increased indirectly due to the interrelationship and interdependence of these industries. Included are such industries as manufacturing, retail and wholesale trade, etc. These conditions will stimulate the economy which will raise the general level of income.

Parts or all of 12 counties within a reasonable commuting distance (50 mile radius) of the project site are eligible for aid pursuant to the Area Redevelopment Act (PL 87-27). Redevelopment benefits credited to the relief of unemployment and underemployment are only those allocated to the 12 eligible counties. In making the benefit allocation, estimates of unemployment were obtained from published sources while quantitative estimates of underemployment were developed on the basis of per capita income and civilian labor force data. It was determined that approximately 30 percent of the total redevelopment benefits would be the amount applicable to redevelopment counties. Current estimates of the Minnesota Department of Manpower Services indicate there are more than 7,000 unemployed construction workers available for work within commuting distance of the project. Of this total, it is estimated that there are approximately 3,500 skilled, 2,100 semi-skilled and 1,400 unskilled workers. Therefore, an ample supply of labor is readily available.

Construction features evaluated include a new conduit, control structures, flood walls, channel modifications and relocations. Total construction cost of the recommended plan is estimated at $7,503,000. On-site labor cost as percentage of total construction cost, is estimated to be approximately 65 percent for urban projects similar to the recommended plan.[1] The distribution of total on-site labor for similar civil works are; skilled 31 percent, semi-skilled and unskilled 49 percent, and administration and supervisory 10 percent.[2] Based on similar projects constructed in the metropolitan area, it was determined that all of the skilled, semi-skilled and unskilled and 50% of the administrative labor required for the project would be hired from the local labor supply and these percentages would result in the amount of wages paid to locally hired unemployed or underemployed labor. Average annual redevelopment benefits credited to the construction phase of the recommended plan were estimated to be $85,400 based on interest and amortization computed at 6-1/8 percent

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1. Engineering News Record, McGraw-Hill, Inc., September 18, 1975, Vol. 195, No. 12, p. 14.

2. IBID., June 19, 1975, Vol. 194, No. 25, p. 77.

TABLE 18

REDEVELOPMENT BENEFITS

Estimated On-Site Labor Cost	
Construction Cost[1]	$7,503,000
Percent of Cost Allocated to Labor	65
On-Site Labor Cost	4,877,000

On-Site Labor by Employment Category

Classification of Labor	Percent	Wages
Skilled	31	$1,512,000
Semi and Unskilled	49	2,877,000
Administrative & Supervisory	10	488,000
		$4,877,000

Allocation of Wages to Unemployed and Underemployed Labor

Classification of Labor	Wages	Percent Locally Hired Labor	Wages Paid to Locally Hired Labor
Skilled	$1,512,000	100	$1,512,000
Semi and Unskilled	2,877,000	100	2,877,000
Administrative & Supervisory	488,000	50	244,000
			$4,633,000

Redevelopment Benefits

Average Annual Value of Local Labor Component	
$4,633,000 x .06141 =	$ 284,500
Amount Applicable as Redevelopment Benefits	
$284,500 x .30 =	$ 85,400

[1] Includes total construction cost, less costs for engineering and design, supervision and administration, and land acquisition.

over an economic life of 100-years. Derivation of these benefits is shown on Table 18.

SUMMARY OF MONETARY BENEFITS

Benefits attributable to the selected flood control plan include tangible flood control benefits from the reduction of flood damages, tangible benefits from expected use of the proposed recreation features, advance replacement benefits, redevelopment benefits, and benefits associated with the decreased threat to human life and public health. Additional tangible benefits which result from the project, which were not evaluated, include the foregone cost of flood proofing, land enhancment, and the savings in the adminstrative costs of flood insurance. Based on October, 1975 prices, a 100-year economic life and a 6-1/8% interest rate, total average annual flood damage reduction benefits attributable to the project are $674,100 and the estimated average annual residual flood damages with the project are $93,800. Average annual recreational benefits attributable to the proposed recreational features are $28,100, advance replacement benefits are $162,000 and redevelopment benefits are $85,400. A summary of the average annual benefits is given in Table 19.

TABLE 19

SUMMARY OF AVERAGE ANNUAL BENEFITS

Item	Average Annual Benefit
Flood Control	$657,100
Recreation	28,100
Advance Replacement	162,100
Redevelopment	85,400
TOTAL	$949,700

ECONOMIC JUSTIFICATION

The selected plan would result in a total average annual benefits of $949,700 and the average annual cost of $633,000. Therefore, the selected plan is well justified economically with a benefit to cost ratio of 1.50.

IMPACTS ON THE NATURAL ENVIRONMENT

When the proposed flood control project is authorized, the implementation of the project can be anticipated to cause impacts on the natural environment. This section of this report discusses these impacts as they are anticipated.

The route followed by the proposed conduit is through an area of existing commercial and industrial development. Portions of the proposed conduit would be constructed as a tunnel underground and portions would be constructed of precast pipe under highway right-of-way or under the right-of-way of existing city streets and, therefore, would not result in any adverse or beneficial impacts on the natural environment.

The construction of the proposed conduit between the existing conduit entrance and the intersection of Third Avenue North and 2nd Street North would not alter normal groundwater levels, except temporarily during construction.

Upon completion of the proposed new conduit and diversion of the Bassett Creek flow from the existing conduit to the proposed conduit, the proposed conduit will create a barrier which will prevent the migration of fish and perhaps certain aquatic invertebrates through the conduit. The fish barrier will be intentionally created by using a steeply sloping section of the conduit or a drop structure in the conduit to prevent the migration of fish through the conduit. According to the Minnesota Department of Natural Resources, preventing the migration of rough fish from the Mississippi River into the Bassett Creek watershed would be a beneficial impact on the natural environment because of the growing magnitude of the rough fish problem throughout the metropolitan area. Although some more desirable fish species will also be prevented from migrating through the conduit into the creek, the long-term benefits which could result from rough fish reduction and the subsequent reduction in the habitat competition for the more desired species is anticipated to enhance

the watershed's sport fisheries. However, before existing populations of rough fish would be reduced, other measures would have to be undertaken in the watershed.

The construction of the flood water storage area in the vicinity of the proposed conduit inlet would involve the excavation of approximately 200,000 cubic yards of earth to provide approximately 90 acre-feet of inundation flood water storage at the proposed 100-year flood level. Many suitable sites exist within the metropolitan area for the disposal of excavated material and specific sites will be designated during post-authorization studies. During periods of normal flow, a wetland pond of approximately 10 acres would occupy a portion of this flood storage area. It is anticipated that this wetland pond would be developed as a Type 4 or Type 5 wetland under the Fish and Wildlife Service's wetland classification. Normal groundwater levels and groundwater quality in the area of the conduit entrance would not be significantly affected by the construction of this wetland pond. The proposed 100-year flood level in the storage area would be approximately 4 feet below the existing 100-year flood level in the area. During the construction of this inundation flood storage area, a temporary reduction in the water quality due to erosion can be expected. Following construction, the water quality of the pond is anticipated to be similar to that of Bassett Creek as it enters the pond. The construction of this flood storage area would result in a severe adverse effect, if not complete destruction of the existing aquatic environment in the 1,500 feet of the creek between the inlet of the existing conduit and Irving Avenue North. The existing fish habitat in this reach supports a variety of small minnows and rough fish. Following the construction at the site, the aquatic environment would, over time, reestablish itself, although the ecological system may be one of a Type 4 or Type 5 wetland pond rather than a confined stream channel. Construction of the flood water storage area at the conduit inlet would disrupt approximately 20 acres of undeveloped land. Animals and birds temporarily disrupted during the construction would include rabbits, mice, rats, morning dove, blackbirds, rackles and several species of song birds. Dominant vegetation includes trees such as boxelder and cottonwood and herbaeous species such as

thistle, white campion, goldenrod and other common weeds. Following construction, landscaping, plantings, sodding and seeding would provide enhanced wildlife habitat in the 10 acres of upland area as well as soil erosion stabilization. The proposed inundation area and wetland pond will provide habitat for limited numbers of waterfowl, marsh birds, song birds and various species of small mammals, reptiles and amphibians.

The construction of the flood wall and a retaining wall in the reach immediately downstream of Glenwood Avenue and the associated channel widening would have long-term adverse impacts on the vegetation and wildlife in the area. Several elm and cottonwood trees of various sizes would be removed from the bank of the creek during the construction of the retaining wall. The channel widening would eliminate some wildlife habitat in the area of construction. Approximately 1/2 acre of wildlife habitat would be permanently destroyed as a result of the channel widening and wall construction. The aquatic habitat of fish and aquatic invertebrates would be temporarily disrupted during the construction, however, no long-term effects are anticipated. The construction of the walls and channel widening would cause a temporary reduction in the water quality of the creek as a result of increased erosion potential and excess turbidity problems. The construction of walls in this reach would reduce the long-term erosion potential in this reach due to the existing conditions. The existing channel walls are in a state of general disrepair and are collapsing in several locations along this reach. As these existing walls deteriorated, stream bank erosion is occurring and would continue to occur in the future without the construction of the proposed walls. Thus, over the long-term, the construction of the proposed walls would improve the water quality of Bassett Creek and reduce the existing erosion potential along this reach.

The increased area of inundation on Theodore Wirth Golf Course would result in temporary disruptions of wildlife habitat during flood periods. Since it is expected that the water level through the golf course will return to about 1 foot above normal within 9 days with proposed conditions as compared to about 7 days with existing conditions following a 100-year flood event, no long-term effects on the wildlife habitat or the existing plant succession are anticipated.

To provide additional drainage for local storm water, a new culvert crossing would be provided at T.H. 55 along the eastern branch of the creek. This branch of the creek currently has undesirable water quality due to water stagnation problems in the reach and providing this new culvert would tend to improve the existing water quality by providing more flow through the area during periods of normal flow and during flood periods.

The increased flood storage in Theodore Wirth Golf Course will result in reduced flood levels along the creek downstream of T.H. 55. As a result of the reduced flood levels downstream of T.H. 55, the existing 100-year flood level on Wirth Lake will be decreased approximately 1.5 feet. The normal water level of Wirth Lake as well as the ponds in Theodore Wirth Golf Course will remain unchanged as a result of the proposed flood control structure and new culvert crossing at T.H. 55. Normal groundwater levels would not be affected by increased flood storage on Theodore Wirth Park, however, groundwater levels during flood periods would be higher than normal for several additional days following flood periods. Because of the short periods of inundation, average annual recharge to deeper aquifers will not change.

Approximately 15 acre-feet of additional flood storage will be provided in the Rice Lake area through landscaping and removal of the demolition debris at the north end of the lake. This will provide an increase in the storage volume on Rice Lake without an increase in the existing flood level. Covering of the demolition debris at the north end of Rice Lake will improve the aesthetic qualities of the area. Restoration and beautification measures will further enhance this natural wetland area. As the vegetative cover establishes itself, wildlife habitat will be enhanced on the periphery of the wetland area and will result in a more diverse ecological system within this urban natural area.

Upstream of T.H. 100, the construction of an embankment and flood control structure would cover approximately 2 acres of land. There would be no long-term adverse effects on wildlife, fish and other aquatic organisms due to the construction of this flood control structure and embankment. There would be temporary adverse effects on the water quality

of the creek due to the erosion potential of the embankment during construction. The embankment would destroy a small undetermined number of small to medium sized trees, some brush areas and the grasses covering the area. Following the construction of this embankment, landscaping and other beautification measures would minimize the long-term adverse affects on the aesthetic quality and wildlife habitat of the area. The construction of the flood control structure will require temporary dewatering during construction, however, groundwater levels would return to normal shortly after construction. Groundwater levels would be higher than normal for several additional days following flood periods because of the increased flood level on Bassett Creek Park, however, because of the short periods of inundation, average annual recharge to deeper aquifers will not change.

A restrictive flood control structure consisting of an earth embankment, culvert and overflow weir would be constructed on Golden Valley Country Club golf course and will occupy approximately 1/3 acre of land. This flood control structure will provide a flood storage area on Golden Valley Country Club golf course at approximately 0.5 feet below the existing 100-year flood level. In the overbank areas, the existing terrestrial environment would be destroyed by the embankment, however, landscaping and plantings would assist the reestablishment of the terrestrial environment following construction. In addition, landscaping, plantings and other beautification measures will minimize the long-term effects on the aesthetic quality of the area.

Immediately upstream of Winnetka Avenue, a restrictive flood storage control structure will be constructed which will occupy approximately 1/6 acre of land. This flood control structure will result in a 100-year flood level upstream of approximately 1 foot above the existing 100-year flood level and will increased the existing flood plain area. The existing terrestrial environment would be destroyed in the overbank area by the embankment, however, landscaping and plantings would assist the reestablishment of the terrestrial environment following construction. Normal groundwater levels in areas upstream of Winnetka Avenue would not be significantly

altered during the construction of the flood control structure nor during flood periods and the average annual recharge to deeper aquifers will not change.

The relocation of the Medicine Lake outlet will permit additional discharge capacity at flood stages without affecting the normal spring high water levels which will preserve the existing fish spawning characteristics of the lake. Approximately 0.2 acres of wetland would be required for construction of the embankment and the water depth would be increased on 0.5 acres of Type 2 wetland changing it to Type 3 or Type 4 wetland.

Between Douglas Drive and Florida Avenue North, a restrictive flood storage control structure will be constructed on the North Branch of Bassett Creek. The construction of this flood control structure would require disruption of approximately 1/6 of an acre of land for the construction of an earth embankment, culverts and overflow weir. The short-term adverse effects on the natural environment would be minimized by landscaping, restoration and beautification measures following the completion of the construction of the embankment. This reach of the North Branch is an intermittent stream and construction of this structure during the driest portions of the construction season when the stream bed is generally dry would minimize the short-term effects of the natural environment and in particular, the water quality and ecological systems. No adverse long-term effects on the natural environment are anticipated as a result of the construction of this flood storage control structure.

Between the flood control structure and Hampshire Avenue North, approximately 26,000 cubic yards of earth would be excavated, three residences would be evacuated, enlarged culverts would be placed at the Florida and Hampshire Avenue channel crossings, and the Georgia Avenue channel crossing would be removed to provide flood water storage in this area. The excavation of this area would result in a short-term adverse impact on the existing wildlife habitat and the existing water quality along this reach of the creek. However, no long-term adverse effects to the natural environment would be anticipated due to landscaping, restoration and beautification measures which would be carried out following the

construction phase. The normal groundwater levels in this area are below the existing stream bed and would not be altered by the construction of the embankment or the excavation of the temporary storage area. The excavation of the three residences and the removal of the Georgia Avenue crossing would result in a net beneficial gain in the natural open space available in this area and would provide a net long-term gain in the potential habitat for birds and small mammals. During the excavation of the flood storage area, an undetermined, but relatively small number of large elm trees would be removed. These trees would be replaced by plantings following the construction of the flood storage sites.

Between Hampshire Avenue and Louisiana Avenue, a flood storage area would be excavated along the existing channel through the backyards of residences along this reach. Approximately 3,400 cubic yards of earth would be removed and an undetermined, but relatively small number of large willow trees would have to be removed as a result of this excavation. The long-term impacts on this action would be minimize through landscaping, restoration and beautification measures following the completion of construction.

SOCIAL AND CULTURAL IMPACTS

Social and cultural impacts can be anticipated as a result of the proposed action. These social and cultural impacts are discussed in the following paragraphs.

RECREATION

The acquisition of approximately 20 acres for flood storage in the area immediately upstream of the conduit entrance provides the opportunity to develop recreational open space along the creek. The area would be developed as an inundation storage area and with a permanent wetland pond to provide a natural area for passive recreational activities during non-flood periods. Development of this natural area along with the biking and hiking trails would enhance the recreational potential of the area. The residents of the area have expressed a desire to enhance the recreational potential of the Bassett Creek corridor in Minneapolis.

Increased flow storage on Brookview, Golden Valley and Theodore Wirth golf courses will increase the adverse effects of flooding on the use of these courses during flood periods. It is anticipated that as a result of the proposed action, that Theodore Wirth and Brookview Community golf courses will be closed for use up to two additional days following a 100-year flood event. The proposed 100-year flood level on Theodore Wirth Golf Course is approximately 2 feet above the existing 100-year flood level and results in the addition of approximately 15 acres to the 100-year flood plain. The proposed flood level on Golden Valley Golf Course is approximately 0.5 feet below the existing 100-year flood level and results in a decrease of approximately 5 acres in the 100-year flood plain. The proposed 100-year flood level on Brookview Community Golf Course is approximately 1 foot above the existing 100-year flood level and results in the addition of approximately 35 acres to the 100-year flood plain. No significant adverse effects on the golf course turf due to sedimentation, waterlogging or accumulation of debris are anticipated to result from the proposed action. Post-flood cleanup expenses will increase slightly due to greather area affected by flood water and has been considered part of the residual flood damages.

Increased flood storage on Bassett Creek Park in Crystal will result in a 100-year flood level approximately 3 feet above the existing 100-year flood level. This results in approximately 10 acres of inundation area being added to the 100-year flood plain. The proposed flood level will not inundate the proposed picnic shelter and pavilion nor will it affect the existing baseball and softball fields and other active recreational facilities in the park. There would be no excavation in the park although the embankment for the flood control structure on the main stem would be constructed along a portion of the east side of the park. Landscaping, plantings and other beautification measures will minimize the adverse effects on the aesthetic quality of the park due to the construction of the embankment.

The proposed action will result in reduced flood levels on two lakes within the watershed. The proposed 100-year flood level on Wirth Lake would be approximately 1.5 feet below the existing 100-year flood level. The reduced flood level on Wirth Lake will result in a reduction of the adverse effects of flooding on the swimming beach. The proposed 100-year flood level on Medicine Lake would be approximately 0.5 feet below the existing 100-year flood level. The reduced flood level on Medicine Lake will provide a minor reduction in the adverse effects of flooding on swimming beaches and proposed boat launching facilities on the lake.

The proposed flood storage area between Douglas Drive and Hampshire Avenue along the North Branch of Bassett Creek will add approximately 2 acres of open space along the creek. Landscaping and restoration following the excavation of the storage site will enhance the aesthetics of approximately 5 acres of existing open space along the creek.

HISTORICAL AND ARCHAEOLOGICAL ASPECTS

Coordination with state and county historical societies and a review of both the National and State Registers of Historic Sites reveals several sites of architectural, archaeological, or historic significance in the general vicinity of the watershed. None of the identified sites would be affected by the project. A surface archaeological reconnaissance of the project area did not identify any sites of historical or archaeological significance which would be affected by this project, however, the reconnaissance did identify areas of high and low archaeological potential in the project area. Those areas identified by the reconnaissance will be subject to intensive archaeological investigation during future project studies.

HUMAN ASPECTS

The evacuation of three residences and the relocation of the residents would cause significant disruption of their life styles. They would experience the considerable personal invonvenience of moving and adjusting to a new neighborhood. This would be considered objectionable by those people affected and this adverse social impact should be considered carefully. One of the three homes is currently owned by the City of Crystal as a result of a tax forfeiture and thus would not require the relocation of people due to the evacuation of this structure. Evacuation of two of the homes allows the development of a flood storage area which would result in a 4 foot reduction in the 100-year flood level in the Markwood Drive area which would remove twenty-six homes from the 100-year flood plain. One of the excavated homes is subject to substantial flood damage as a result of existing flood level. Thus, the long-term social benefits resulting from the evacuation of these three homes would seem far greater than the short-term adverse social effects.

Flood proofing of nineteen homes in the watershed would cause short-term disruption of the life styles and personal inconvenience to the affected residents during the flood proofing modifications. However, the long-term reduction in the flood threat and related economic losses sustained by the property owners would at least partially offset the short-term adverse social effects of flood proofing. Most of these homes would be subject to only minor flooding of walk-out basements and the residents may wish to obtain flood insurance in lieu of the flood proofing modifications.

Throughout the watershed, the construction of the improved culvert crossings of the creek would cause temporary local disruption of traffic patterns. Suitable alternate routes are available at each location which an improved culvert crossing is proposed. The removal of the Minnaqua Avenue crossing of the main stem and the Georgia Avenue crossing of the North Branch would generally be acceptable to the local residents and suitable alternate routes are available.

Beneficial social impacts of the proposed action would include flood protection for about 220 families and 18 businesses thereby reducing economic losses, community disruption and potential threats to public health and safety incurred during flood periods. Adverse social impacts would include evacuation of three homes and relocation of two families, flood proofing of about nineteen homes and temporary disruption of the aesthetic qualities in localized areas due to construction of structural flood control features.

AESTHETIC ASPECTS

All structural features of the proposed project would be subjected to additional beautification measures to minimize the adverse effects on the aesthetic quality of the stream environment. These proposed beautification measures would consist of rustication of all visible concrete surfaces, all earth embankments would be subjected to landscaping and planting measures to enhance their visual appearance at necessary locations, visual barriers consisting of wooden fences and/or shrubbery will be constructed to enhance the aesthetic qualities of the natural stream setting. During post-authorization studies, beautification and aesthetic enhancement should be major considerations in final layout and design of project features.

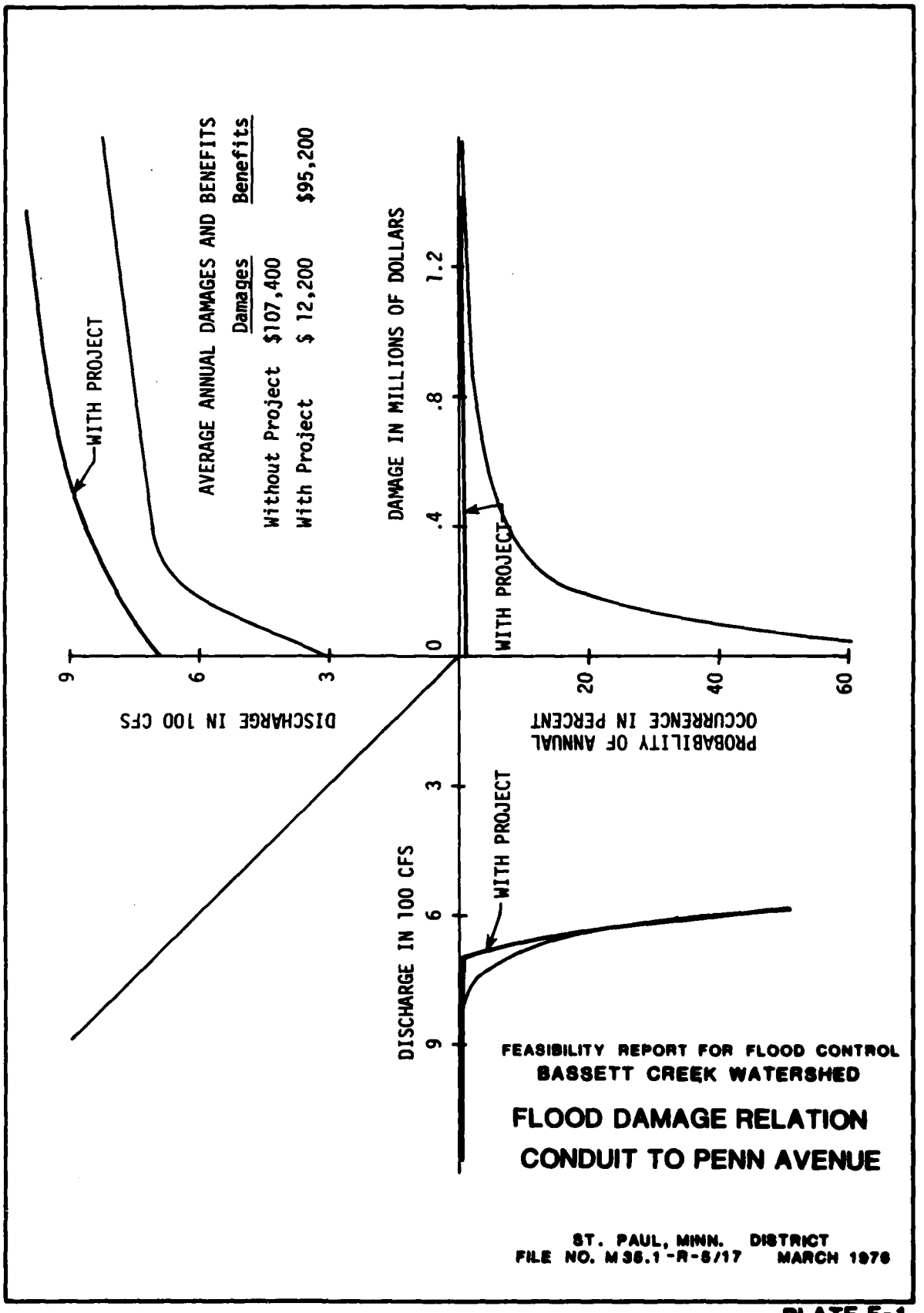

AVERAGE ANNUAL DAMAGES AND BENEFITS
Damages Benefits
Without Project $107,400
With Project $ 12,200 $95,200
WITH PROJECT
DISCHARGE IN 100 CFS
9
6
3
0
DAMAGE IN MILLIONS OF DOLLARS
.4
.8
1.2
WITH PROJECT
PROBABILITY OF ANNUAL OCCURRENCE IN PERCENT
20
40
60
DISCHARGE IN 100 CFS
3
6
9
WITH PROJECT
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED
FLOOD DAMAGE RELATION
CONDUIT TO PENN AVENUE
ST. PAUL, MINN. DISTRICT
FILE NO. M36.1-R-8/17 MARCH 1978

PLATE F-1

SECTION G

DIVISION OF PLAN RESPONSIBILITIES

DIVISION OF PLAN RESPONSIBILITIES

Table of Contents

	Page
INTRODUCTION	G-1
COST APPORTIONMENT	G-1

List of Tables

	Page
APPORTIONMENT OF COSTS AMONG INTERESTS	G-2
ANNUAL CHARGES	G-3

SECTION G
DIVISION OF PLAN RESPONSIBILITIES

The major purpose of this section is to present pertinent information regarding cost apportionment between Federal and Non-Federal interests for the proposed plan. The proposed improvements are generally for a single purpose, however, related recreational and aesthetic measures are included. Since the recreational facilities and resulting benefits do not have a decisive influence on project feasibility, the recreational purpose and costs were considered incidental and cost allocation between project purposes was not considered appropriate.

COST APPORTIONMENT

Apportionment of cost for the proposed improvement between Federal and Non-Federal interests is based on existing Federal lesiglative and administrative policies governing flood control. In this regard, all costs associated with construction of a new conduit including road replacements, installation of flood walls, modification of the existing channel, the construction of control structures to create temporary inundation areas and aesthetic treatments are assigned to the Federal government. In addition, the Federal government would pay a share of that portion of the proposed conduit between the outlet and the intersection of Third Avenue North and Washington Avenue, which would be constructed for cooperative purposes by the Minnesota Department of Highways. The percent of Federal participation in the cooperative drainage conduit will be in proportion to the ratio of the contributing flow or peak discharge of Bassett Creek, 700 cubic feet per second, to the sum of the contributing flows or peak discharges in the cooperative conduit, 1,835 cfs. The Federal government would also pay a share of that portion of the proposed conduit which would be constructed for cooperative purposes as part of the flood control project, from Third Avenue North and Washington Avenue to approximately 11th Street North and Glenwood Avenue, based on the ratio of the contributing flow or

peak discharge of the highway project, 700 cfs, to the sum of the contributing flows or peak discharges in the cooperative conduit, 850 cfs. Local interests would provide all lands, easements and rights-of-ways; pay for all modifications to existing channel crossings; make necessary relocations and/or modifications of utilities; pay for all roadway raises except those required due to increased flood storage levels; and operate and maintain the project after completion.

Local interests would also bear one-half of the first costs of all recreational facilities and the total cost for their operation and maintenance.

The distribution of costs including appropriate engineering design, supervision, and administration costs is shown on Table 1.

TABLE 1

APPORTIONMENT OF COSTS AMONG INTERESTS

Item	First Costs Federal	First Costs Non-Federal	Total
Land, Right-of-Way, Easements	$	$1,619,000	$ 1,619,000
Relocations	360,000	989,000	1,349,000
Channels	5,150,000		5,150,000
Floodwalls	401,000		401,000
Recreation Facilities	131,000[1]	23,000[1]	154,000
Flood Control Structures	449,000		449,000
Engineering, Administration	838,000	180,000	1,018,000
TOTAL	7,329,000	2,811,000	10,140,000

[1]Cost apportionment based on a 50% Federal, 50% Non-Federal cost sharing policy for Recreational Facilities minus credit for lands.

All maintenance, operation and replacement costs for the proposed project are assigned to Non-Federal intersts. The portions of the project constructed in highway right-of-way will be maintained by the Minnesota Highway Department and cost shared with local sponsors based on peak flow ratios. Estimated annual charges based on a 6-1/8 percent interest rate and a 100-year project economic life are given in Table 2. No interest during the construction has been applied to the annual charges, as it is anticipated that the project would be completed in two consecutive construction seasons or slightly more than one year.

TABLE 2

ANNUAL CHARGES

Federal Annual Charges		
Interest and Amortization (7,329,000 x .06141)		$450,000
Non-Federal Annual Charges		
Interest and Amortization (2,911,000 x .06141)	$173,000	
Maintenance	10,000	
Total Non-Federal Annual Charges		183,000
Total Project Annual Charges		$633,000

SECTION H

DESIGN CONSIDERATIONS
AND
DETAILED COST ESTIMATES

DESIGN CONSIDERATIONS AND DETAILED COST ESTIMATE

Table of Contents

Item	Page
GENERAL	H-1
GEOLOGY AND SOILS	H-1
GEOLOGY	H-1
SUBSURFACE INVESTIGATIONS	H-1
SUBSURFACE CONDITIONS	H-2
EMBANKMENT CONFIGURATION	H-2
ROAD RAISES	H-2
SOILS DESIGN CONSIDERATIONS	H-3
Seepage and Uplift	H-3
Stability and Settlement	H-3
Riprap	H-3
Construction Materials	H-4
HYDROLOGY AND HYDRAULICS	H-5
STORM CHARACTERISTICS	H-5
STREAM FLOWS	H-6
WATERSHED CHARACTERISTICS	H-6
HYDROLOGIC ANALYSIS	H-9
HYDRAULIC DESIGN	H-16
WATER SURFACE PROFILES	H-16
FLOOD OUTLINE MAPS	H-17
VELOCITIES	H-17

Table of Contents (Continued)

Item	Page
RIPRAP PROTECTION	H-20
HYDRAULICS OF SELECTED PLAN	H-20
DETAILED COST ESTIMATE	H-26
BASIS FOR COST ESTIMATE	H-26
FIRST COSTS	H-26
ESTIMATE OF ANNUAL CHARGES	H-34
REFERENCES	H-35

List of Tables

SUMMARY OF DISCHARGE MEASUREMENTS--BASSETT CREEK WATERSHED	H-7
SUMMARY OF DATA FOR COMPUTATION OF RUNOFF HYDROGRAPH WITH EXISTING CONDITIONS 100-YEAR FREQUENCY, 24-HOUR RAINFALL	H-14
COMPARISON OF 100-YEAR FLOOD DISCHARGES WITHOUT PROJECT	H-15
DISCHARGES AND MANNING'S "N" VALUES AT VARIOUS LOCATIONS.	H-18
100-YEAR FREQUENCY FLOOD FLOW VELOCITIES	H-19

Plates

Plate No.	
H-1	SOIL BORING LOCATIONS
H-2	BORING LOGS
H-3	ANDERSON'S BASIN LAG VERSUS BASIN CHARACTERISTICS
H-4	BASIN LAG VERSES BASIN CHARACTERISTICS
H-5	BASIN LAG VERSES UNIT HYDROGRAPH PEAK
H-6	SUB-WATERSHED DIVIDES
H-7	DISCHARGE FREQUENCY RELATIONSHIP
H-8	DISCHARGE FREQUENCY RELATIONSHIP

Plates (Continued)

Plate No.	
H-9	DISCHARGE FREQUENCY RELATIONSHIP
H-10	DISCHARGE FREQUENCY RELATIONSHIP
H-11	100-YEAR FLOOD HYDROGRAPHS
H-12	100-YEAR FLOOD HYDROGRAPHS
H-13	FLOOD HYDROGRAPHS - CONDUIT AREA
H-14	FLOOD PROFILE MAIN STEM
H-15	FLOOD PROFILE MAIN STEM
H-16	FLOOD PROFILE MAIN STEM
H-17	FLOOD PROFILE MAIN STEM
H-18	FLOOD PROFILE MAIN STEM
H-19	FLOOD PROFILE MEDICINE LAKE
H-20	FLOOD PROFILE MEDICINE LAKE
H-21	FLOOD PROFILE MEDICINE LAKE
H-22	FLOOD PROFILE NORTH BRANCH
H-23	FLOOD PROFILE NORTH BRANCH
H-24	FLOOD PROFILE SWEENEY LAKE
H-25	FLOOD OUTLINE MAP - EXISTING CONDITION
H-26	FLOOD OUTLINE MAP - PROPOSED CONDITION
H-27	FLOOD WALLS AND RETAINING WALLS - GLENWOOD AVENUE
H-28	CONTROL STRUCTURE - BASSETT CREEK PARK
H-29	CONTROL STRUCTURE - DOUGLAS DRIVE-FLORIDA AVENUE

SECTION H
DESIGN CONSIDERATIONS AND DETAILED COST ESTIMATES

GENERAL

This section presents a detailed discussion of the data used in designing the selected plan. Included are discussions of geologic and soils studies, hydrologic and hydraulic design studies, in support of the overall study. Also included in this section is a detailed estimate of first cost and annual costs for the selected plan.

GEOLOGY AND SOILS

GEOLOGY

Bedrock below the surface of the Bassett Creek watershed consists of Cambrian and Ocdovician sedimentary rocks, predominantly sandstones, limestones and dolomites. Elevation of the bedrock surface varies from 600 to 800 feet above mean sea level in the study area. The relief of the bedrock surface is a result of stream erosion and glacial action during previous glacial epochs. Glacial ice contact and outwash sediments cover the bedrock surface to the present day elevations of 800 to 900 feet. The glacial sediment cover reaches a maximum thickness of approximately 250 feet over two pre-existing stream valleys which extended through the watershed. The surfacial sediments consist of marsh and swamp deposits 5 to 60 feet thick, glacial till 5 to 40 feet thick and stratified outwash sediments deposited by streams 25 to 250 feet thick.

SUBSURFACE INVESTIGATIONS

Six soil borings were taken to determine subsurface conditions within the Bassett Creek watershed near the locations of possible improvements. The boring locations are shown on Plates H-1 and the boring logs are shown on Plate H-2. Additional soil boring data which were made available by the Minnesota Highway Department and other government and private

sources were also reviewed, however, these soils data were generally not in the immediate vicinity of proposed improvements. Geologic maps published by the Minnesota Geological Survey were used to determined the bedrock and surfacial geology of the watershed. Detailed soils investigations in the immediate vicinity of the proposed structures and along the route of the proposed conduit will be required in later design stages.

SUBSURFACE CONDITIONS

The available soils and geologic information generally indicate that the foundation provided in the project area is extremely variable. As shown on the borings on Plate H-2, the charateristics of the deposits range from sands and gravel to clay and peat. Peat and organic deposits are characteristics of the low-lying wetland areas, while deposits of mixtures of coarse and fine grained material typical of glacial and fluvial deposition are characteristic of channel areas.

EMBANKMENT CONFIGURATIONS

Embankment sections will consist of pervious fill and the side slopes of the proposed embankments will be varied to conform and blend with existing topography wherever possible. The maximum side slope will not exceed 1V:3H. The top width of the embankments varies from 10 to 20 feet.

ROAD RAISES

With the proposed plan, portions of the several bituminous covered streets throughout the watershed would be raised. The maximum change in elevation would be about 2.5 feet and the average road raise would be about 1.5 feet. It is anticipated that existing foundation conditions are capable of supporting the proposed raise. The effect of the road raise on existing utilities will be investigated in later design stages. Normal road surface removal and stripping should be adequate to provide a suitable roadway foundation. Road surfacing design would conform to local design practices.

SOILS DESIGN CONSIDERATIONS

Seepage and Uplift

Most of the proposed embankments will impound average heads of from 2 to 7 feet for the design storm. It is not expected that these heads will cause any major seepage or uplift conditions which would materially affect the cost of the structures. The embankment upstream of Douglas Drive would have a height of 18 feet and could pose more significant seepage and uplift problems. A detailed investigation will be required when additional subsurface information is available. However, due to the short 150 foot length of this embankment, it is not expected that the cost of seepage and uplift control measures would be significant, if required.

Stability and Settlement

Due to the small height of the embankments, embankment stability is not expected to be a major design consideration. Future soils investigations and laboratory analysis of the soils properties in the immediate vicinity of the embankments will be required for detailed stability analysis . If these investigations disclose unusually weak foundation conditions for the proposed structures, consideration will be given to removing these deposits. If these investigations indicate that excessive settlement of the embankments will occur, consideration will also be given to possible stabilization measures.

Riprap

Riprap protection would be provided for areas where flood velocities would cause erosion. These areas would include the downstream side of the storage area outlet structures and at the downstream side of small channel crossings. Riprap protection of embankments from wave action appears to be unnecessary due to the short fetches and short duration of high water in the temporary storage areas.

Construction Materials

All construction materials including coarse and fine concrete aggregate and riprap are commonly available in the Minneapolis-St. Paul metropolitan area. Borrow for embankments is available from several reliable sources within a 10 mile radius of the proposed project. Some of the excavation for the impoundments can be disposed of at the proposed construction site and several potential disposal areas are located within the watershed. Other potential disposal areas include a commercial landfill within 15 miles of the project area.

HYDROLOGY AND HYDRAULICS

STORM CHARACTERISTICS

In Minnesota, precipitation generally results from one of two types of situations, either as a result of a mixing and convergence of air in frontal areas or due to convection activity within an unstable air mass (Baker, 1967). The frontal situation generally produces the high intensity, short duration precipitation which causes critical floods in urban areas similar to the Bassett Creek watershed. Warm fronts result from the movement of warm air masses from the Gulf straight northward replacing cooler air masses while cold fronts result from the movement of cold polar air masses from Canada replacing warm air masses. Because of the steep slope and greater speed of cold fronts, more rapid lifting occurs in the leading edge generally resulting in precipitation of greater intensity and shorter duration than that associated with warm fronts.

It has been calculated that approximately 90% of the precipitation in the Mississippi River Basin comes from an external source (Benton, 1950) and the most important of these is the flow of moisture from the Gulf of Mexico. The importance of moisture from the Gulf is clearly illustrated by the precipitation and vegetal patterns of areas surrounding Minnesota. The Minnesota precipitation pattern results from the seasonal changes in the general circulation system as represented by the resultant winds. In January, west and northwest winds dominate while in April, the Gulf winds begin to reach southeastern Minnesota and dominate until October. During the six-month period, April through September, approximately 70% of the annual precipitation in the area of the Bassett Creek watershed occurs. All of the major historical floods have occurred during the summer months as a result of intense rainfall. Because of the small size of the watershed, snowmelt does not significantly affect flood flows, however, snowmelt runoff associated with early spring precipitation can produce critical flood levels on lakes in the watershed.

STREAMFLOWS

There are no continuous streamflow records available for the Bassett Creek watershed, however, the U.S. Geological Survey has collected limited streamflow data at four partial-record stations in the watershed since 1952. There are two stations on the main stem of Bassett Creek, one located at the County Road 66 bridge in Golden Valley and the other located near Fruen Mill in Minneapolis. In addition, there is a station on the North Branch at the 34th Avenue North culvert in Crystal and on the Sweeney Lake Branch at the Highway 55 culvert in Golden Valley. Generally, discharges have been measured several times per year at each station. The data collected at these stations is summarized in Table 1.

In addition to these miscellaneous measurements, the Bassett Creek Flood Control Commission installed a crest-stage gage on the main stem of Bassett Creek just upstream of Fruen Mill in 1972. The maximum discharge recorded at this station was 250 cubic feet per second on June 7, 1974. This discharge was the result of an intense rainstorm which occurred in the western areas of the watershed on June 6, 1974. Approximately 3½ inches of rainfall fell in a 6-hour period in the western portion of the watershed, while approximately 2½ inches in that same period fell in the eastern portions of the watershed. The most intense portion of the storm in the western areas of the watershed approximated a 25-year frequency rainfall event. A more severe storm occurred in June, 1942. Based on highwater marks near Fruen Mill and the conduit entrance, it has been estimated that this storm approximated a 50-year frequency rainfall event.

WATERSHED CHARACTERISTICS

Bassett Creek begins upstream of Medicine Lake in a branch known as Plymouth Creek. In the upper portions of this reach, development is sparce and agricultural and open areas dominate, however, near Medicine Lake the watershed tributary to Plymouth Creek becomes more developed. From its source to Medicine Lake, the average slope of Plymouth Creek is approximately 17 feet per mile with the slopes being much steeper on either side of

TABLE 1

SUMMARY OF DISCHARGE MEASUREMENTS

BASSETT CREEK WATERSHED[1]

Water Year	Main Stem Golden Valley	Main Stem Minneapolis	North Branch Crystal	Sweeney Lake Branch Golden Valley
	Number of Discharge Measurements and Range of Discharges Measured			
1952[2]		(1) 21.6 cfs		
1954[2]		(9) 2.9-122 cfs		
1963	(8) 3.5-45.2 cfs	(8) 6.2-117 cfs	(8) 0-18.5 cfs	(8) 1.1-9.0 cfs
1964	(11) 0.5-20.5 cfs	(10) 0.8-19.4 cfs	(10) 0-5.1 cfs	(10) 0.8-8.3 cfs
1965	(9) 0.8-84.8 cfs	(10) 2.3-181 cfs	(7) 0-31.3 cfs	(7) 0.8-29.0 cfs
1966	(9) 4.4-66.7 cfs	(9) 2.1-274 cfs	(7) 0-2.4 cfs	(8) 1.3-8.5 cfs
1967	(9) 1.7-49.0 cfs	(9) 0.1-81.0 cfs	(8) 0.8-11.6 cfs	(9) 1.5-12.8 cfs
1968	(7) 1.1-60.5 cfs	(7) 5.4-165 cfs	(6) 0.1-2.0 cfs	(8) 1.1-2.3 cfs
1969	(9) 5.2-116 cfs	(9) 4.1-234 cfs	(6) 0-3.9 cfs	(5) 1.1-10.0 cfs
1970	(6) 2.4-27.1 cfs	(6) 2.5-30.4 cfs	(6) 0-3.0 cfs	
1971	(7) 4.4-108 cfs	(7) 6.7-13[illegible] cfs	(7) 0-31.4 cfs	(2) 0.7-41.1 cfs
1972	(7) 5.2-25.6 cfs	(7) 5.4-25.8 cfs	(7) 0.6-3.0 cfs	(4) 1.1-1.5 cfs

[1]Water Resources Data for Minnesota, United States Department of the Interior Geological Survey.

[2]Measurements also made at other miscellaneous locations during 1954.

several marsh areas which it flows through. In this reach, the channel is very irregular and undefined in the marsh areas.

As Bassett Creek leaves Medicine Lake, it flows through a large marsh, then begins winding through the urbanized portions of Golden Valley, Crystal and Minneapolis, entering a conduit through which it flows approximately 1½ miles to the Mississippi River. The major portion of the watershed tributary to the main stem in Golden Valley and Minneapolis is urbanized. The slope of this reach varies considerably from less than 3 feet per mile between Winnetka Avenue and Medicine Lake and in the Wirth Park area to more than 17 feet per mile between Hampshire Avenue and Pennsylvania Avenue. The average slope of this reach between Medicine Lake and the Mississippi River is approximately 9 feet per mile and its length in this reach is 12.1 miles.

Between Medicine Lake and the conduit, Bassett Creek is joined by two branches, the North Branch and the Sweeney Lake Branch. The North Branch flows through portions of Plymouth, New Hope and Crystal and joins the main stem immediately upstream of Highway 100. The major portion of the areas surrounding the channel in Crystal and New Hope are urbanized. In the upper half of the reach, the slope of the channel is fairly flat, however, in the lower half, the slope is approximately 25 feet per mile. The average slope of the channel in this reach is approximately 12 feet per mile. The channel valley varies significantly in this reach with portions being shallow with flat overbanks and portions being deeply incised with steep overbanks. Approximately 1,500 feet of this reach flows through a conduit which is just downstream of Northwood Pond. The Sweeney Lake Branch drains portions of St. Louis Park and Golden Valley and joins the main stem in Wirth Park. Throughout most of this reach, the creek flows through a series of ponds and marshes and the channel is generally undefined. From the Minnesota Northern and Southern Railroad to the point where it flows into Sweeney Lake, a distance of 1.1 miles, the creek drops approximately 23 feet.

Sweeney and Medicine Lakes form large natural flood storage areas for their subwatersheds because both lakes have fairly restrictive outlets.

The major portion of the floodflows tributary to them will go into storage. In addition, Northwood Pond has a restrictive outlet and provides natural storage for floodflows from the upper North Branch watershed. In the 19 miles of main stem, North Branch and Sweeney Lake Branch channel, there are 62 channel crossings or other obstructions, most of which restrict floodflows. The most significant of these on the main stem are the crossings at Highway 55 and Winnetka Avenue in Golden Valley, at Highway 100 in Crystal, at Dresden Lane and Golden Valley Road in Golden Valley, at Highway 55 near Wirth Park in Golden Valley, and the conduit in Minneapolis. All of these crossings and the conduit significantly reduce peak channel discharges because of their restrictive nature which cause large areas to become inundated immediately upstream of each of them during flood periods. On the North Branch, there are seven channel crossings in less than a mile and on the Sweeney Lake Branch there are nine channel crossings in about a mile, all of which are restrictive to major flood flows. In addition, there are several upland storm drainage ponds in the watershed which provide substantial flood storage for their tributary subwatersheds.

HYDROLOGIC ANALYSIS

As previously discussed, the process of urbanization in the Bassett Creek watershed is well advanced with the eastern areas of the watershed almost completely developed while the extreme western portions are only partially developed. In the past several years, the central portion of the watershed, including areas of Golden Valley, Plymouth, New Hope and Crystal, have been subject to intense development pressure.

Urban development drastically alters the natural drainage pattern and hydrologic characteristics of a watershed. Infiltration characteristics are reduced by the covering of permeable soils with impervious surfaces, the extent of modification depending on the type and density of urban land use. Small natural depressions are filled and graded smooth, reducing the natural depression storage in the watershed. Storm sewer and channel improvements provide hydraulically efficient means of removing storm runoff. These factors result in increased storm runoff volumes and

higher peak runoff rates, because of decreased rainfall losses and quicker response to precipitation because of more efficient drainage systems.

Because the watershed is rapidly urbanizing, discharge-frequency relations will change as urban development continues. In the preliminary study, discharge-frequency relationships were developed for the existing state of urbanization to evaluate the extent of flood damages and for ultimate development of the watershed, as design discharges for the analysis of the effect of alternative flood control measures. A mathematical model of the watershed was used which generated synthetic runoff hydrographs, based on a synthetic rainfall hyetograph and statistical rainfall data. The method was based on work by Keifer and Chu (1957), Horton (1940), Tholin and Keifer (1960), Horner and Jens (1941), and others. The lack of extensive streamflow data precluded verification of the effects of urbanization, however, the model was used to reproduce 1942 highwater marks which were available in the lower reaches of the watershed.

In this study, unit hydrographs were developed and routed using the Hydrologic Engineering Center Program, 723-X6-L2010. With an absence of data in Minnesota to document the effects of urbanization, studies in other areas of the country which have documented these changes were reviewed to evaluate the various input parameters.

Taylor and Schwarz (1952) studied the effect of basin characteristics on the computation of synthetic unit hydrographs for 20 basins located in the North and Middle Atlantic states which followed the reasoning previously demonstrated by Snyder (1938) that lag time was a function of basin characteristics. Linsey (1958) presented a correlation of lag in terms of basin characteristics based on the study of 18 natural basins in California. From Linsey's correlation, lag time could be estimated for basins of similar characteristics. Carter (1961) studied 20 streams in the Washington, D. C. vicinity following the reasoning of Snyder and developed a relationship for lag time for natural basins, partially sewered basins and completely sewered basins. Eagleson (1962) determined that a

relationship, similar to that derived by Linsey, existed for urban basins based on the data collected by the Louisville District, Corps of Engineers, on a number of small heavily urbanized areas in Louisville, Kentucky. A very complete analysis of the effects of urbanization was made by Anderson (1968) in his study of 64 gaging stations in Fairfax County, Virginia, and confirmed the conclusions of Carter. Others including VanSickle (1968) and Nelson (1970) established relationships between basin lags and watershed characteristics for various degrees of urban development for watersheds in Houston and Dallas, Texas, respectively.

A plot of Anderson's curves of basin lag as a function of basin characteristics is shown on Plate H-3. Included on Plate H-3 are specific data points for urban basins as determined by Anderson. The data points for natural basins, as determined by Anderson, are not shown. Data for natural basins and urban basins, as determined by others, are also shown on Plate H-3.

The definition of basin lag varied among the various data sources from the definition by Snyder as the time between the center of mass of rainfall - excess to the occurrence of the resulting peak discharge. For example, Anderson defined basin lag as "the average time from the centroid of rainfall excess to the centroid of direct runoff" which differs slightly from Snyder's definition. From a review of various measured runoff hydrographs, this difference was determined to be insignificant for small urban areas. Where definitions for basin lag differed from Anderson's definition, the data for larger watersheds were not plotted.

The curve developed by Linsey for natural basins of moderate slope and the curves developed by Eagleson and VanSickle for urban basins as a function of basin characteristics are shown on Plate H-4. Also shown on Plate H-4 are data points from other sources for watersheds with moderate slopes.

Points indicating the peak of the unit hydrograph for various basins as a function of lag time are plotted and are shown on Plate H-5. In most

cases, the data for all three figures were determined from isolated runoff events caused by fairly high intensity rainfall. In some instances, the data plotted represents the average of several storms. Generally, the data from various areas of the country are similar for small urban basins and comparable for natural basins with similar characteristics.

To determine the peak discharge at various points along the channel, the watershed was subdivided into 42 sub-basins varying in size from 0.13 to 9.44 square miles. Generally, the outlet of each of the sub-basins was at a restrictive channel crossing as previously discussed. For each sub-basin, the percentage of impervious area with existing development conditions and with expected ultimate development were determined. Soils data were reviewed and the infiltration losses were determined for each sub-basin for existing and ultimate conditions. The average estimated loss including depression storage and interception losses ranged from 0.28 inches per hour to 0.48 inches per hour with existing urbanization and from 0.15 inches per hour to 0.43 inches per hour with ultimate urbanization. Sub-watershed divides are shown on Plate H-6.

Point rainfall depths of various durations for the 10, 50 and 100-year rainfall were obtained from the National Weather Service Technical Report No. 40, "Rainfall Frequency Atlas of the United States", and were adjusted for areal distribution. Rainfall-depth-duration-frequency relations were determined from these data in accordance with EM1110-2-1410.

Hypothetical hyetographs of rainfall excess were determined using the method described in Appendix C of EM1110-2-1410. Because of the large amounts of temporary storage in the lakes, ponds and behind restrictive channel crossings, the rainfall sequence adopted is generally not critical since these storage effects modulate the effects of varying hyetograph assumptions. In the Preliminary Feasibility Study, the design storm hyetograph was based on the work of Keifer and Chu (1957) and Breihau and Armistead (1940).

The lag time for each sub-basin was estimated from the curve shown on Plate H-4 based on the characteristics of the sub-basin and the peak of the unit hydrograph was then determined from the curve shown on Plate H-5

based on the estimated sub-basin lag. Again, the effects of both the natural storage in the watershed and the effects of the storage behind the many restrictive channel crossings will modulate the effects of varying assumptions in the determination of unit hydrograph characteristics. Synder coefficients were calculated from the estimated unit hydrograph peak and sub-basin lag and runoff hydrographs for each sub-basin were determined and routed through the watershed using HEC-1. Characteristics of the various sub-basins are listed in Table 2. For each storage area, discharge-storage relationships were determined and the runoff hydrograph from upstream areas was routed through storage using reservoir routing techniques.

Channel flood flows computed for the Preliminary Feasibility Study and this study are compared in Table 3. In some instances, storage-discharge relationships for major flood storage areas were revised to reflect changed conditions or newly acquired information. In these cases, the channel discharges determined in the Preliminary Feasibility Study were revised to reflect the revised storage discharge relationship. Discharge frequency curves for various locations are shown on Plates H-7 through H-10. The 100-year flood hydrographs for various locations are shown on Plates H-11 and H-12.

The determination of Standard Project Flood discharge differs significantly from the determination of the 100-year frequency flood. In the case of the Standard Project Flood, the runoff volume represents that which could be expected from the most severe combination of meteorological and hydrologic conditions which are reasonably characteristic of this geographic region. The standard project storm rainfall and rainfall excess were determined using procedures presented in Civil Engineering Bulletin No. 52-8, EM 1110-2-1411. Standard Project Flood discharges at various locations along the creek are listed in Table 4.

TABLE 2

SUMMARY OF DATA FOR COMPUTATION OF

RUNOFF HYDROGRAPH WITH EXISTING CONDITIONS

100-YEAR FREQUENCY, 24-HOUR RAINFALL

Watershed Designation	Watershed Area (acres)	Length of Drainage Path (miles)	Average Slope (percent)	Impervious Area (percent)	Water Surface Area (percent)	Landlocked Area (percent)	Estimated Lag (hours)	Unit Hydrograph Peak (cfs)	Runoff Hydrograph Peak (cfs)	Runoff Volume (acre-feet)	Percent of Total Rainfall
MS1	454	1.33	.6	39	0	7	.25	697	1,038	84	62
MS2	394	.91	1.3	32	0	0	.21	731	1,048	80	64
MS4[1]	504	1.1	1.1	17	5	0	.35	657	1,030	95	59
MS5[1]	680	1.63	.5	47	0	0	.21	1,260	1,875	110	51
MS6	108	.89	2.7	31	0	0	.19	181	278	27	66
MS7	550	1.4	1.3	20	5	0	.40	560	944	100	57
MS8	173	1.9	.9	24	0	0	.40	198	332	32	58
MS9	685	1.17	.5	37	2	9	.25	1,025	1,525	124	62
MS10	444	1.25	.7	29	4	0	.35	557	941	86	61
MS11	84	.57	1.7	31	8	0	.30	157	222	18	66
MS12	150	.47	1.2	31	0	0	.15	261	377	31	66
MS14	444	1.14	.3	21	0	0	.56	399	731	83	59
MS15	1,340	2.84	.1	31	5	0	.85	898	1,938	302	70
MS16	430	1.29	.5	22	5	4	.34	546	943	88	66
MS18	525	.75	.7	28	13	0	.28	1,072	1,512	121	72
ML1	3,694	6.2	1.2	15	28	8	.84	4,066	8,657	1,326	69
ML2	965	1.74	.6	20	9	25	.41	825	1,495	163	70
ML3	469	.81	.9	20	13	0	.18	733	1,119	105	70
ML4	630	1.32	.9	11	6	0	.54	563	1,079	130	65
ML5	572	1.13	.6	16	4	20	.45	419	769	92	62
ML8	703	1.96	.8	19	13	0	.38	831	1,464	149	66
ML9	997	1.71	.7	12	5	0	.65	821	1,596	199	62
ML10	456	1.14	.5	10	16	0	.41	519	917	96	66
ML11	981	2.28	.7	8	6	0	1.30	465	1,004	190	61
ML12	363	.98	.5	8	13	0	.41	416	736	77	66
NB1	458	.86	1.0	27	3	37	.21	535	770	60	65
NB2	281	.87	.6	23	0	0	.36	352	608	58	65
NB3	794	1.36	.9	25	3	0	.33	953	1,700	168	66
NB4	286	.72	1.1	18	0	0	.30	412	710	65	70
NB5	378	1.29	1.0	10	7	0	.55	340	655	79	66
SL1	310	1.1	2.3	27	29	0	.15	743	1,100	97	70
SL2	144	.42	1.5	21	5	0	.19	208	327	33	70
SL3	272	.51	1.1	28	0	54	.25	103	184	26	63
SL4	276	.61	1.2	18	3	18	.27	348	558	50	70
SL5	484	1.29	.6	31	4	0	.26	770	1,200	107	69
SL6	693	1.34	.8	29	5	40	.27	767	1,228	111	70

[1]Combined storm sewer and sanitary sewer in this area.

TABLE 3

COMPARISON OF 100-YEAR FLOOD DISCHARGES

WITHOUT PROJECT

	Preliminary Feasibility Study		Current Study	
	Existing Conditions	Ultimate Conditions	Existing Conditions	Ultimate Conditions
Main Stem				
Medicine Lake	110	110	106	111
Winnetka Avenue	729	800	777	830
County Road 102 (Douglas Drive)	753	815	769	825
Highway 100	1,064	1,140	1,016	1,171
Golden Valley Road	891	960	865	952
Highway 55	804	863	855	890
Sweeney Lake Branch				
Sweeney Lake	108	136	97	108
North Branch				
County Road 18	105	172	144	144
Northwood Pond	51	53	51	52

HYDRAULIC DESIGN

The proposed plan reduces flooding by a combination of additional flood storage, channel and channel crossing modifications and a new outlet. Implementation of this plan includes the construction or repair of outlet structures at several storage areas, improving 12 channel crossings, channel modifications, and a conduit inlet. This portion of the report describes the procedures and criteria used in the preliminary design of the required channel modifications and structures. In addition, this section describes the methods used in computing existing and proposed water surface profiles and in preparing flood outline maps.

WATER SURFACE PROFILES

Water surface profiles for Bassett Creek were determined for the 100-year flood, 100-year flood with proposed conditions, Standard Project Flood and Standard Project Flood with proposed conditions. The profiles are shown on Plates H-14 through H-24. The discharges used for the profile computations were calculated using HEC-1. The Hydrologic Engineering Center Program 723-X6-L202A (HEC-2) was used to calculate the water surface profile in the reaches between temporary storage areas. The water surface elevation in the temporary storage areas at the time of the greatest inflow as calculated using HEC-1 was used for the starting water surface elevation of each reach.

Because of the restrictive nature of the existing conduit, temporary ponding or storage will occur at the existing conduit entrance with both the 100-year flood and Standard Project Floods. To determine the starting water surface elevation in the vicinity of the conduit entrance, both the 100-year flood and Standard Project Flood were routed through this temporary storage using HEC-1.

Manning's "n" values were estimated from field inspection, stream photographs, and topographic maps. In general, a Manning's "n" value of .012 was used for concrete culverts and .024 was used for corrugated metal pipe culverts. A list of channel discharges and Manning's "n" values

at specific locations are shown on Table 4. Roughness coefficients for channels varied between .035 and .045 and overbank roughness coefficients for overbank areas varied between .045 and .10.

The water surface profiles for the 100-year flood with proposed conditions and the Standard Project Flood with proposed conditions were estimated using rating curves developed by the HEC-2 computer program, the volume-discharge curves for the proposed storage areas, and the water surface profiles for the 100-year flood and the Standard Project Flood.

FLOOD OUTLINE MAPS

Flood outline maps which delineate the area inundated by the 100-year flood, the Standard Project Flood, the 100-year flood with proposed conditions and the Standard Project Flood with proposed conditions are shown on Plates H-25 and H-26. These maps were prepared from the water surface profiles and 2-foot contour interval maps.

VELOCITIES

Flow velocities for Bassett Creek with proposed conditions were determined from the HEC-2 computer program for reaches where there would be no change from existing conditions. For reaches where channel modifications or discharge changes are proposed, velocities were either calculated or determined from the HEC-2 computer program.

Flow velocities throughout the Bassett Creek watershed are generally low. Table 5 lists locations where channel velocities exceed 7.0 fps or overbank velocities exceed 2.0 fps. Most of the areas of high velocity flow are located at the outlet of bridges or culverts. Generally, flow velocities will be reduced where existing channel crossings are replaced by larger culverts and downstream of Glenwood Avenue where the channel will be slightly enlarged. Depending on soil conditions, riprap may be used at these sites to prevent erosion. High velocities at the outlets of the proposed storage areas could be reduced by energy dissipators, or erosion would be prevented by using riprap or lining the channel.

TABLE 4

DISCHARGES AND MANNING'S "N" VALUES AT VARIOUS LOCATIONS

MAIN STEM

Distance Above Junction With Mississippi River	DISCHARGE			MANNING'S "N"		
	100-Year Ultimate Development[1]	100-Year Proposed	Standard Project Flood[1]	Channel	Overbank	
Miles	cfs	cfs	cfs		Left	Right
2.05	1,055	1,055	2,600	.04	.05,.07	.05,.07
2.69 Mill Area	890	700	1,750	.035	.05	.05
3.09 Wirth Park Sta	890	700	1,750	.035	.05	.05
5.32 Downst of Noble	950	640	1,800	.04	.07	.07
5.81	950	640	1,300	.035	.05	.05
6.69	880	520	1,490	.045	.09	.09
7.95	825	420	1,360	.035	.05	.05
8.86	855	400	1,000	.045	.065	.065
9.02 (48th St)	830	400	990	.04	.065	.065

NORTH BRANCH

Distance Above Junction With Main Stem						
0.42	1,300	1,390	2,200	.035	.065	.065
0.53	600	1,100	1,100	.04	.07	.07
0.78	310	530	330	.045	.08	.08
1.04	260	410	295	.04	.065	.065
1.38	290	800	300	.04	.065	.065

[1]Ultimate watershed development, existing channel.

TABLE 5

100-YEAR FREQUENCY FLOOD

FLOW VELOCITIES[1]

Distance from Junction with the Mississippi River (miles)	Left Overbank (fps)	Channel (fps)	Right Overbank (fps)	Structure
Main Stem				
2.06		8.7		Cedar Lake Road Bridge
2.68		8.3		Freun Mill Dam
4.51		13.1		Golden Valley Road Crossing
5.42	2.6	10.3	3.3	
6.55	2.5	8.7	2.8	
6.69	4.2	10.5	4.2	
7.89	3.3	9.0	2.8	M.N. and S.R.R. Bridge
7.97	3.4	9.4	2.5	

NORTH BRANCH

Distance from Junction with the Main Stem (miles)				
0.49		13.4		32nd Avenue Crossing
0.57		12.5		Brunswick Avenue Crossing
0.68		8.0	2.5	
0.70	2.5	8.5	3.0	
0.80		15.3		34th Avenue Crossing
0.99		8.8		Douglas Drive Crossing

[1]Velocities listed for cross-sections that have channel velocities greater than 7.0 fps or overbank velocities greater than 2.0 fps.

RIPRAP PROTECTION

Riprap protection would be provided at each bridge, culvert outlet, improved channel and outlet structure where, depending on soil conditions, velocities would be great enough to cause erosion. An evaluation of the need for erosion protection will be based on future detailed soils investigations. Riprap protection from wave action on the dike at the Bassett Creek Park storage area is unnecessary due to short fetch and short duration of high water.

HYDRAULICS OF SELECTED PLAN

The hydraulic design of culverts was based on Manning's formula. A Manning's "n" value of .012 was used for reinforced-concrete pipe and pipe arches. Headwalls, wing walls and flared aprons will be installed where there is a need to increase the capacity of the culvert or to prevent erosion. At certain sites, culverts would be oversized in order to provide freeboard for the passage of debris and ice or equipped with trash racks to prevent debris from entering and lodging in the culverts. The possibility of reducing culvert sizes by assuring inlet control will be investigated further in later design stages.

Channel improvements were also designed using Manning's formula. A Manning's "n" value of .03 was used for excavated earth channels with grass side slopes and for channels with an earth bottom and concrete sides. Channels would be designed for easy maintenance, stable side slopes and adequate freeboard. Depending on soil conditions, the channel would be designed for velocities that would not result in erosion or the soil would be protected by gravel or riprap.

The hydraulic design of the various components of the outlet structures such as weirs, outlet pipes, energy dissipators and embankments was based on

the procedures presented in TM5-820-4. A Manning's "n" value of .012 was used in the design of all reinforced-concrete outlet pipes. To prevent erosion downstream of the outlet structures, velocities would be reduced by energy dissipators or the channel could be protected by riprap. Erosion at the entrance to weirs and outlets pipes could be prevented by using headwalls, wingwalls or riprap. Trash racks may be used at some sites to prevent debris from severely obstructing flow. All outlet structures were designed for the 100-year flood, but would be capable of passing the Standard Project Flood with negligible increases over the existing Standard Project Flood Level.

The proposed temporary storage area immediately upstream of the proposed conduit provides storage for a portion of the first peak of the inflow which reduces the required discharge capacity of the conduit. Without temporary storage at the conduit entrance, the non-cooperative portion of the proposed conduit from 11th Street North and Glenwood Avenue to the existing inlet near Dupont Avenue North, would have to be designed to pass the first peak of the inflow hydrograph or approximately 1,600 cfs as shown on Plate H-13. Without temporary storage at the conduit entrance, the required discharge capacity of the cooperative portion of the conduit would be approximately 2,500 cfs because portions of the first peak of inflow from Bassett Creek and portions of the inflow from highway drainage areas would coincide. With temporary storage at the conduit entrance, the non-cooperative portion of the conduit would be designed to pass the second peak of the inflow hydrograph which would be 700 cfs with storage on Theodore Wirth Golf Course. The cooperative portion of the proposed conduit from 3rd Avenue North and Washington Avenue North would be an 11-foot tunnel and it would have a discharge capacity of 1,350 cfs which would pass the peak flow from highway drainage areas and approximately 100 cfs from Bassett Creek. The peak flow from highway drainage areas occurs approximately 2-1/2 hours after runoff begins and the second peak of inflow from Bassett Creek occurs approximately 19 hours after runoff begins. Flow from highway drainage areas would end 6 hours after runoff begins and the chances that the second peak of inflow from Bassett Creek and inflow from highway drainage areas would coincide would be extremely remote. The proposed non-cooperative portion of the conduit was

designed to pass the 100-year discharge of 700 cfs with the hydraulic gradeline at optimum depth. The discharge capacity of the proposed non-cooperative conduit would be unaffected by tailwater on the Mississippi River because of the 45 feet of elevation difference between the conduit entrance and the high water levels on the Mississippi River.

The proposed conduit would operate under a head with Standard Project Flood conditions, however, the existing Standard Project Flood level at the existing conduit entrance would be reduced by approximately two feet. The discharge in the proposed conduit would be approximately 1,600 cfs with Standard Project Flood conditions as shown on Plate H-13.

The existing low head rock dam downstream of Glenwood Avenue would be replaced by an ogee dam and a 40-foot stilling basin as shown on Plate H-27. The crest of the proposed ogee dam would be at the elevation of the existing dam. With design flows, a 25-foot long hydraulic jump would occur downstream of the ogee dam and the stilling basin would be necessary to prevent scour of the channel. The proposed flood wall on the left bank of the channel in this area would be approximately 1-foot above the design flood profile. Coincidental runoff from approximately 2.5 acres of interior drainage area would either have to be pumped or temporarily stored in a ponding area inside the flood walls. A low area near the southeast corner of the protected area could be excavated for use as a temporary ponding area. The ponding area would be connected to the creek with a gated gravity outlet which would allow the pond to drain when the creek returns to normal stage. The ponding area would store runoff from a 50-year frequency flood at a flood level approximately 0.5 foot below existing parking areas. With Standard Project Flood flows, a flow split from the main channel of the creek upstream of the flood walls would occur and the area protected by the flood walls would be inundated. Extensive relocation of Glenwood Avenue, Burlington Northern, Inc. and Minnesota Northern and Southern Railroad would be required to prevent the flow split with Standard Project Flood flows, therefore, it would not be feasible to raise the flood walls to provide Standard Project Flood protection for this area.

The Wirth Park control structure would consist of two 88" x 54" arch culverts installed immediately upstream of the existing box culverts at Highway 55. A headwall would be installed at the inlet of the arch culverts and would connect to the wingwalls of the existing box culverts. The inverts of the proposed arch culverts would be slightly lower than the elevation of the existing weirs in the box culverts which will maintain the pond in the golf course at its existing level with normal flows in Bassett Creek. With design flows, the proposed arch culverts will operate under approximately 2 feet more head than the existing box culverts providing additional temporary flood water storage in Wirth Park. The tailwater elevation on the existing box culverts would be reduced by approximately 1.5 feet, which would result in a reduction of flow into Wirth Lake from the creek and a lowering of the flood level on the lake. With flood flows in excess of the design flow, the headwall and wingwall will function as weirs to pass excess flow. The Standard Project Flood flow would overtop Highway 55 west of the existing box culverts and flow into Wirth Lake at a point which is approximately 1 foot above the design flood level in Wirth Park.

The Bassett Creek Park control structure would consist of a 122" x 78" arch culvert through an earth embankment and a 130-foot overflow weir as shown on Plate H-28. The proposed arch culvert would be approximately 50 feet upstream of the existing box culverts at Highway 100 and the invert would be at the elevation of the existing channel bottom. Existing water levels in Bassett Creek would not be affected by the proposed arch culvert with normal flows in the creek. With design flood flows, the proposed arch culvert would operate under approximately 3 feet more head than the existing box culverts at Highway 100 providing additional temporary flood water storage in Bassett Creek Park. The overflow weir would pass flood flows in excess of design flows until the discharge capacity of the box culverts at Highway 100 are exceeded and the highway is overtopped. With the Standard Project Flood, the highway would be overtopped and the resulting tailwater on the embankment would be higher than the proposed embankment. The embankment would be 2 feet above the design flood level in Bassett Creek Park.

The proposed control structure in the Golden Valley Country Club golf course would consist of two 36-inch culverts and a 25-foot long fixed crest overflow weir. The inverts of the proposed culverts would be at the elevation of the existing channel bottom and the existing water levels in the creek would not be affected with normal flows in the creek. With design flows, a 2-foot head differential would occur at the structure providing additional temporary flood water storage in the golf course. The resulting flood level in the golf course will be slightly less than the existing flood level because the proposed increased temporary flood water storage on Brookview Community Golf Course upstream significantly reduces flood flows from upstream areas. With the Standard Project Flood, there would be only minor head losses at the proposed structure because of backwater effects of existing downstream channel crossings.

The proposed control structure upstream of Winnetka Avenue would consist of two 36-inch culverts and a 25-foot long fixed crest overflow weir. It would be located approximately 100 feet upstream of Winnetka Avenue and the inverts of the proposed culverts would be at the elevation of the existing channel bottom. The existing water levels in Bassett Creek would not be affected with normal flow in the creek. With design flows, a 3-foot head differential would occur at the structure providing additional temporary storage on Brookview Community Golf Course. With the Standard Project Flood, there would be only minor head losses at the proposed structure because of backwater effects of donwstream crossings.

The existing Medicine Lake control structure will be relocated approximately 500 feet downstream of the existing structure and approximately 50 feet upstream of the Minnesota Western Railroad embankment. The structure would consist of a 20 foot fixed crest overflow weir at elevation 887.7 which would maintain the lake at its existing normal level and a 360 foot overflow embankment at elevation 889. The discharge characteristics of the proposed structure would be the same as the existing structure up to elevation 889 and, therefore, normal high spring water levels would not be affected. With design flows, the discharge capacity of the proposed structure would be greater than the existing structure which would reduce

the flood level of Medicine Lake. In addition, two 115" x 72" arch culverts would be installed under the railroad embankment to reduce tailwater effects on the proposed structure.

The proposed control structure between Douglas Drive and Florida Avenue on the North Branch of Bassett Creek would consist of a drop structure with a 73" x 45" arch culvert and 30 foot weir inlet and two 169" x 107" arch culvert outlets as shown on Plate H-29. The invert of the proposed arch culverts would be at the elevation of the existing channel bottom and with normal flow in the creek existing water levels would not be affected. With design flows, the proposed structure would operate with a seven foot head differential which would provide additional temporary flood water storage upstream of the structure. The overflow weir would pass flows in excess of the design flow including the Standard Project Flood without overtopping the proposed embankment. The proposed embankment would be 3.5 feet above the design flood level.

DETAILED COST ESTIMATE

BASIS FOR COST ESTIMATE

Estimated costs are based on unit prices adjusted to reflect average bid prices received on similar work by the St. Paul District. An allowance of 20 percent for contingencies is included in the estimated costs.

FIRST COSTS

The detailed estimate first costs for work recommended by this report are given in the following table with costs shown based on October, 1975, price levels. The estimated cost of lands is based on estimated market values provided by municipalities in the Bassett Creek watershed and from records of recent sales. The estimated land cost also includes an allowance for temporary construction easements and permanent maintenance easements.

Detailed Estimate of First Costs

	Unit	Quantity	Unit Cost	Total Cost
Federal First Costs				
Relocations				
Flood Proofing (19 homes)				$ 128,100
Evacuation (3 homes)				171,600
Contingencies Relocations				59,900
Total Relocations[1]				$ 360,000
Channels				
Conduit				
102" R.C.P.	L.F.	1,915	$ 230.00	440,500
Tunnel 8-1/2' Drift	L.F.	800	950.00	760,000
Shaft 10'	L.F.	40	490.00	19,600
Remove Existing 10' x 10' Box	L.F.	200	55.00	11,000
Manholes	Ea.	9	2,670.00	24,000
Entrance Structure				
Reinforced Conc.	C.Y.	45	210.00	9,500
Trash Rack	Job	Sum	--	3,200
Manhole Casting	Ea.	1	400.00	400
Excavation and Backfill	C.Y.	50	4.25	200
Restoration	Job	Sum	--	1,600
Street Replacement				
Glenwood Ave. (Conc. Base)	S.Y.	1,450	32.00	46,400
Second Ave. (Asphalt)	S.Y.	5,800	12.00	69,600
Federal Share of Cooperative Facility				
Third Ave. to Outfall				1,025,000
Eleventh Street to Third Ave.				926,000
Channel Modifications				
Clearing and Snagging	Job	Sum	--	27,000
Channel Excavation	C.Y.	6,480	3.50	22,700
Remove Concrete Box	L.F.	100	55.00	5,500
Remove 60" R.C.P.	L.F.	80	21.00	1,700
Remove Bridge	Job	Sum	--	5,000
Sod and Topsoil	S.Y.	3,700	1.60	5,900
Seed	Ac.	.5	500.00	300
Plantings	Job	Sum	--	55,000

Detailed Estimate of First Costs (cont.)

	Unit	Quantity	Unit Cost	Total Cost
Federal First Costs (cont.)				
Channels (cont.)				
Inundation Areas				
Excavation and Haul	C.Y.	246,100	$ 3.50	$ 861,400
Topsoil	C.Y.	4,030	4.25	17,100
Sod	S.Y.	5,000	1.00	5,000
Seed	Ac.	10	500.00	5,000
Plantings	Job	Sum	--	55,000
Road Raises and Resurfacing				
29th Avenue North Fill	C.Y.	1,400	3.25	4,600
29th Avenue North (Asphalt)	S.Y.	1,500	12.00	18,000
Boone Avenue Fill	C.Y.	1,300	3.25	4,200
Boone Avenue (Asphalt)	S.Y.	2,660	12.00	31,900
Contingencies Channels				687,500
Total Channels				5,150,000
Flood Walls				
Excavation	C.Y.	1,600	3.00	4,800
Remove Existing Timber Wall	L.F.	130	16.00	2,100
Sheet Pile (PMA-22)	S.F.	26,700	9.00	240,300
Pile Cap Reinforced Conc.	C.Y.	170	270.00	45,900
Weir Reinforced Conc.	C.Y.	18	350.00	6,300
Riprap Protection	C.Y.	675	21.00	14,200
Riprap Filter	C.Y.	220	13.00	2,900
Timber Retaining Wall	Job	Sum	--	9,600
12" R.C.P. - With Flap Gate	L.F.	200	28.00	5,600
Sod	S.Y.	2,200	1.00	2,200
Contingencies Flood Walls				66,800
Total Flood Walls				401,000
Recreation Facilities				
Bridge	S.F.	1,440	27.00	38,900
Paved Trail	Mi.	1.9	27,000.00	51,300
Exit-Entrance Points	Ea.	6	550.00	3,300
Signing	Job	Sum	--	2,000

Detailed Estimate of First Costs (cont.)

	Unit	Quantity	Unit Cost	Total Cost
Federal First Costs (cont.)				
Recreation Facilities (cont.)				
Bicycle Racks	Ea.	3	$ 640.00	$ 1,900
Walkway Steps	Ea.	2	1,600.00	3,200
Parking Lot	S.Y.	2,500	5.25	13,100
Contingencies Recreation Facilities				27,000
Total Recreation Facilities[2]				154,000
Flood Control Structures				
Wirth Park Control				
88" x 54" R.C.P.-A	L.F.	16	110.00	1,800
88" x 54" R.C.P.-A Aprons	Ea.	2	1,280.00	2,600
Reinforced Conc. Weir	C.Y.	44	200.00	8,800
Sheet Pile (PMA-22)	S.F.	1,680	9.00	15,100
Excavation and Backfill	C.Y.	375	4.25	1,600
Riprap	C.Y.	40	27.00	1,100
Riprap Filter	C.Y.	20	16.00	300
Restoration and Rustication	Job	Sum	--	1,600
Bassett Creek Park Control				
122" x 78" R.C.P.-A	L.F.	20	190.00	3,800
Stripping	C.Y.	1,000	0.80	800
Inspection Trench	C.Y.	3,600	1.30	4,700
Excavation and Backfill	C.Y.	3,000	6.50	19,500
Embankment Fill	C.Y.	34,650	3.25	112,600
Sheet Pile (PMA-22)	S.F.	2,000	9.00	18,000
Pile Cap Reinforced Conc.	C.Y.	70	270.00	18,900
Riprap	C.Y.	380	21.00	8,000
Riprap Filter	C.Y.	180	9.00	1,600
Seed	Ac.	1.3	500.00	700
Restoration and Rustication	Job	Sum	--	2,100
Medicine Lake Control				
Remove Existing Structure	C.Y.	20	55.00	1,100
Stripping	C.Y.	1,200	0.80	1,000
Embankment Fill	C.Y.	2,700	3.25	8,800
Reinforced Conc. Weir	C.Y.	30	270.00	8,100

Detailed Estimate of First Costs (cont.)

	Unit	Quantity	Unit Cost	Total Cost
Federal First Costs (cont.)				
Flood Control Structures (cont.)				
Sheet Pile (PMA-22)	S.F.	760	$ 9.00	$ 6,800
Riprap	C.Y.	100	21.00	2,100
Riprap Filter	C.Y.	50	9.00	500
Seeding	Ac.	1	500.00	500
Restoration	Job	Sum	--	1,100
Brookview Control				
Excavation and Backfill	C.Y.	100	6.50	700
36" R.C.P.	L.F.	60	65.00	3,900
Reinforced Conc. Weir	C.Y.	20	270.00	5,400
Sheet Pile (PMA-22)	S.F.	300	9.00	2,700
Embankment Fill	C.Y.	250	3.25	800
Riprap	C.Y.	45	21.00	900
Riprap Filter	C.Y.	20	11.00	200
Restoration and Rustication	Job	Sum	--	500
Golden Valley Golf Control				
Excavation and Backfill	C.Y.	50	4.25	200
36" R.C.P.	L.F.	60	65.00	3,900
Reinforced Conc. Weir	C.Y.	20	270.00	5,400
Embankment Fill	C.Y.	540	3.25	1,800
Riprap	C.Y.	40	21.00	800
Riprap Filter	C.Y.	20	11.00	200
Restoration and Rustication	Job	Sum	--	500
Douglas Drive - Florida Avenue Control				
Excavation	C.Y.	200	3.25	700
73" x 45" R.C.P.-A	L.F.	16	85.00	1,400
73" x 45" R.C.P.-A Aprons	Ea.	1	850.00	900
169" x 107" R.C.P.-A	L.F.	48	250.00	12,000
169" x 107" R.C.P.-A Aprons	Ea.	2	3,750.00	7,500
Sheet Pile (PMA-22)	S.F.	800	8.50	6,800
Reinforced Conc. Weir	C.Y.	75	235.00	17,600
Embankment	C.Y.	5,000	3.25	16,300
Riprap	C.Y.	60	21.00	1,300
Riprap Filter	C.Y.	30	11.00	300
Restoration and Rustication	Job	Sum	--	1,100
Contingencies Flood Control Structures				74,900
Total Flood Control Structures				449,000

Detailed Estimate of First Costs (cont.)

	Unit	Quantity	Unit Cost	Total Cost
Federal First Costs (cont.)				
Engineering and Design[3]				$ 494,000
Supervision and Administration[3]				
Inspection				247,000
Overhead				121,000
Total Cost (Federal First Costs and Non-Federal Contributions)				7,376,000
Non-Federal Contributions[4]				145,000
Total Federal First Costs				7,231,000
Non-Federal First Costs				
Lands and Damages				
Flood Easements (Increased Inundation Area	Ac.	55	$ 4,500.00	248,000
Land Purchase and Const. Easements				1,047,000
Recreation Lands	Ac.	1	54,000.00	54,000
Contingencies				269,800
Total Lands and Damages				1,619,000
Relocations				
Improved Channel Crossings				
8' x 10' Precast Box (36th-Hampshire)	L.F.	260	240.00	62,400
169" x 107" R.C.P.-A (Westbrook)	L.F.	90	250.00	22,500
169" x 107" R.C.P.-A Aprons	Ea.	2	3,750.00	7,500
154" x 97" R.C.P.-A (Regent, Noble)	L.F.	440	260.00	114,400
154" x 97" R.C.P.-A Aprons	Ea.	8	3,150.00	25,200
122" x 78" R.C.P.-A (32nd)	L.F.	120	160.00	19,200
122" x 78" R.C.P.-A Aprons	Ea.	2	1,920.00	3,800
115" x 72" R.C.P.-A (C&NWRR)	L.F.	60	140.00	8,400
115" x 72" R.C.P.-A (Brunswick)	L.F.	80	140.00	11,400
115" x 72" R.C.P.-A Aprons	Ea.	4	1,600.00	6,400
102" x 62" R.C.P.-A (34th)	L.F.	70	120.00	8,400

Detailed Estimate of First Costs (cont.)

	Unit	Quantity	Unit Cost	Total Cost
Relocations (cont.)				
102" x 62" R.C.P.-A Aprons	Ea.	2	$1,390.00	$ 2,800
108" R.C.P. (Florida)	L.F.	460	220.00	101,200
72" R.C.P. (Douglas)	L.F.	260	130.00	33,800
48" R.C.P. Jacked (T.H. 55)	L.F.	210	80.00	16,800
Riprap Protection	C.Y.	1,380	21.00	29,000
Riprap Filter	C.Y.	650	11.00	7,200
Repaving	Job	Sum	--	7,700
Wing Wall Repair (Pile Cap)	C.Y.	50	320.00	16,000
Road Raises				
Road Surface Removal	Job	Sum	--	2,200
Fill	C.Y.	4,200	3.25	13,700
Resurface Asphalt	S.Y.	13,010	10.00	130,100
Utility Relocations				
Sanitary Sewer				
86" R.C.P. Pile Pipe	L.F.	320	130.00	41,600
Wood Pile	L.F.	2,400	4.25	10,200
Pile Caps	Ea.	30	235.00	7,100
Remove 86" R.C.P.	L.F.	500	21.00	10,500
36" R.C.P.	L.F.	200	60.00	12,000
12" R.C.P.	L.F.	250	37.00	9,300
8" R.C.P.	L.F.	1,800	17.00	30,600
Manholes 0-8	Ea.	10	540.00	5,400
Watermain				
24" C.I.P.	L.F.	100	75.00	7,500
12" C.I.P.	L.F.	130	53.00	6,900
8" C.I.P.	L.F.	60	37.00	2,200
6" C.I.P.	L.F.	480	27.00	13,000
Storm Sewer				
24" R.C.P.	L.F.	280	48.00	13,400
12" R.C.P. C.B. Leads	L.F.	160	28.00	4,500
Catch Basins	Ea.	4	500.00	2,000
Contingencies Relocations				164,900
Total Relocations				989,000
Engineering and Design				89,000
Supervision and Administration				
Inspection				45,000
Overhead				22,000

Detailed Estimate of First Costs (cont.)

	Unit	Quantity	Unit Cost	Total Cost
Non-Federal First Costs (cont.)				
Non-Federal Contributions				
Flood Proofing (20% of Est. Cost)				$ 31,000
Relocation (20% of Est. Cost)				41,000
Recreation Facilities (50% of Est. Cost)				77,000
Indirect Costs[5]				23,000
Less 50% of Recreation Lands				27,000
Total Non-Federal Contributions				145,000
Non-Federal First Costs				2,909,000
Total Project First Cost[6]				10,140,000

1. Includes 20% Non-Federal Contribution
2. Includes 50% Non-Federal Contribution
3. Includes Non-Federal Contribution for Indirect Costs on Relocations and Recreation Facilities
4. Includes Items 1, 2, 3 Above, Less 50% of Cost of Recreation Lands
5. Non-Federal Contribution for Engineering and Design, Supervision and Administration for Relocations and Recreation Facilities
6. Exclusive of Preauthorization Study Costs

ESTIMATE OF ANNUAL CHARGES

Annual charges for the proposed improvements are based on an interest rate of 6-1/8 percent and an amortization period of 100 years. Estimates of the maintenance and operation of the proposed improvement are based on maintenance cost data available for similar work in the area. The table below summarizes the estimated annual charges for the flood protection plan in the Bassett Creek watershed.

Estimated Annual Charges

	Annual Charges
Total first Cost	$10,140,000
Interest and amortization	623,000
Operation, maintenance, and major replacements	10,000
Total annual charges	$ 633,000

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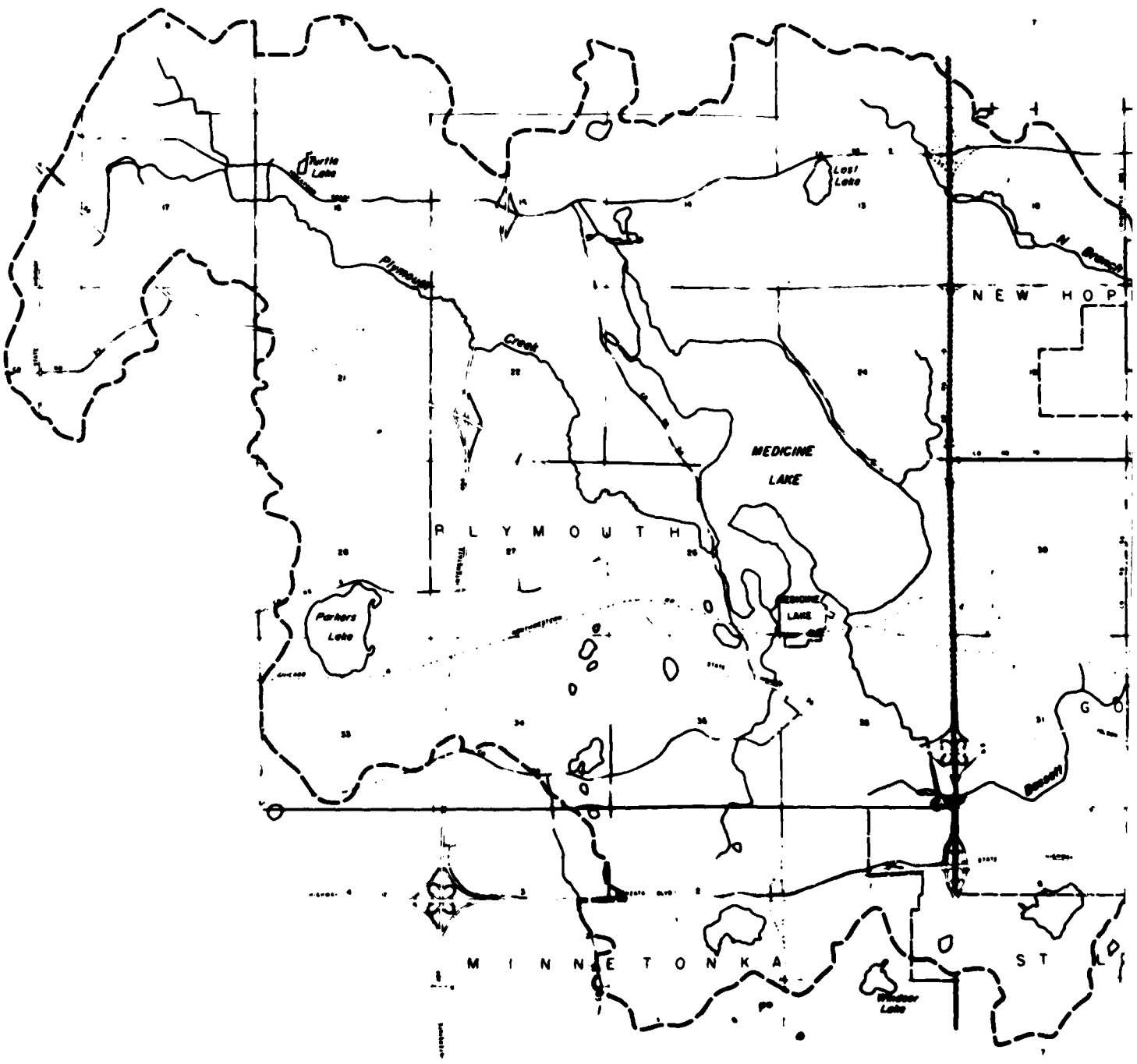
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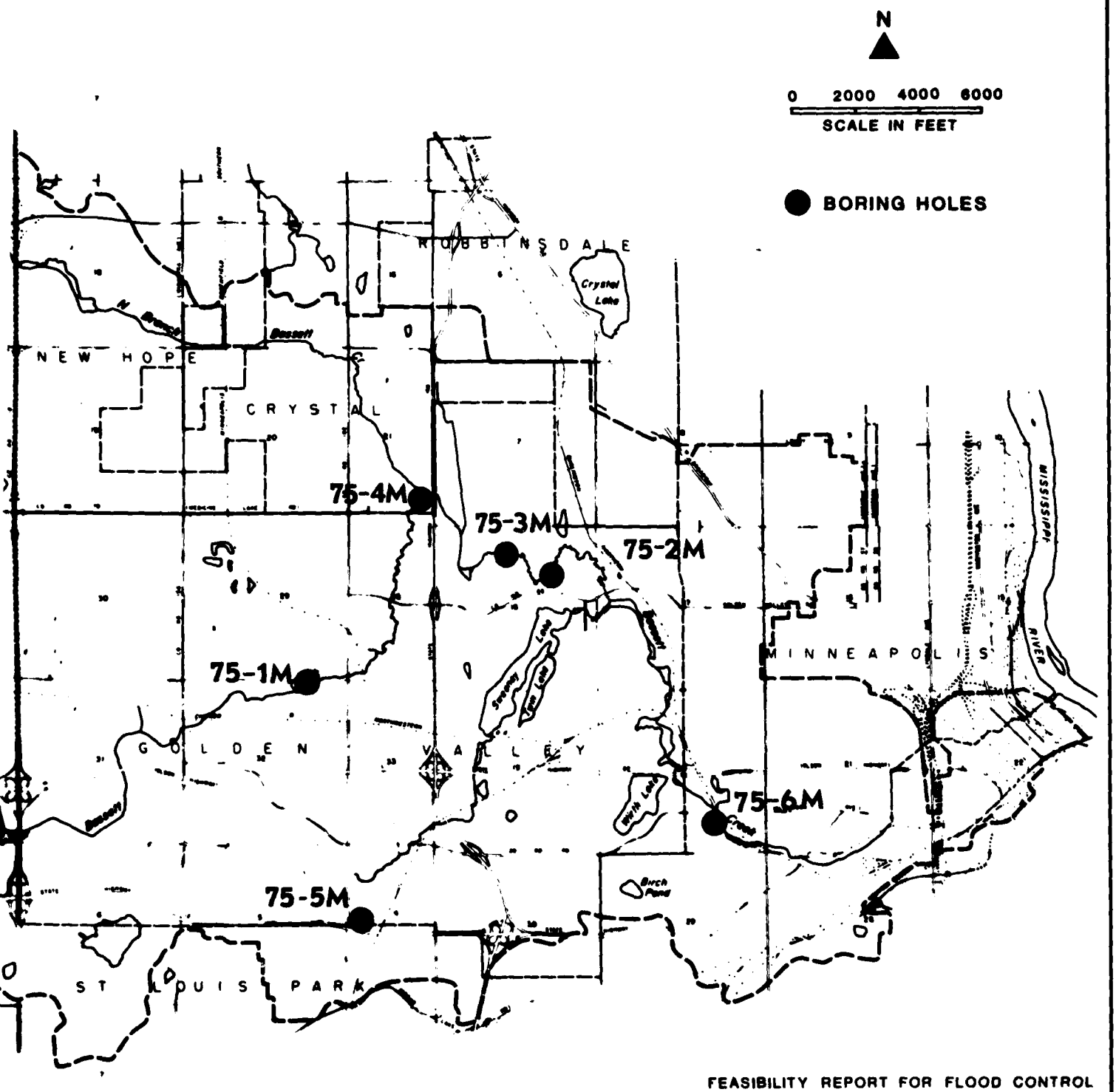
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Turtle Lake
Lost Lake
Plymouth Creek
MEDICINE LAKE
PLYMOUTH
Parkers Lake
MINNETONKA
Wolsner Lake
NEW HOP



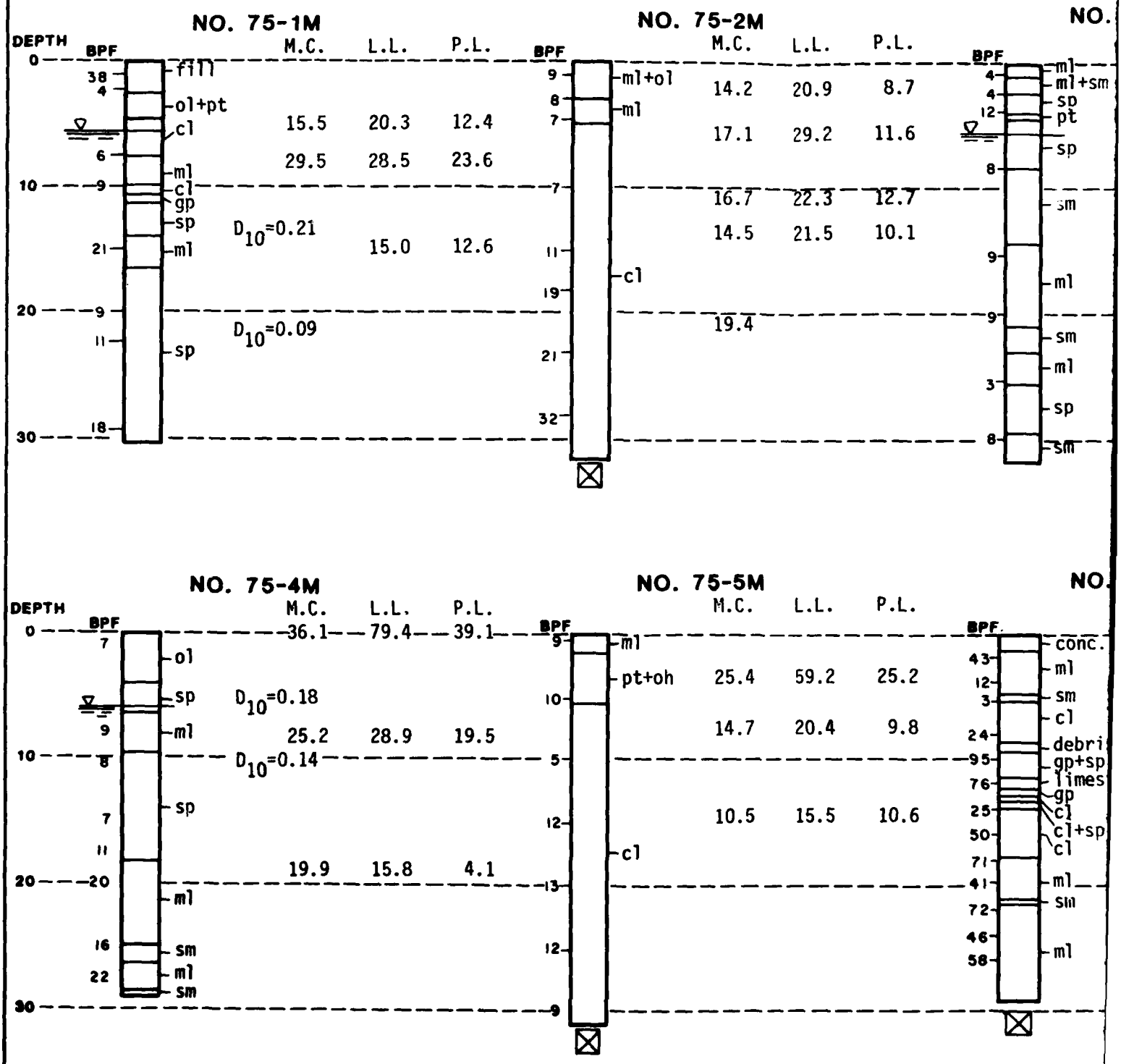
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

2

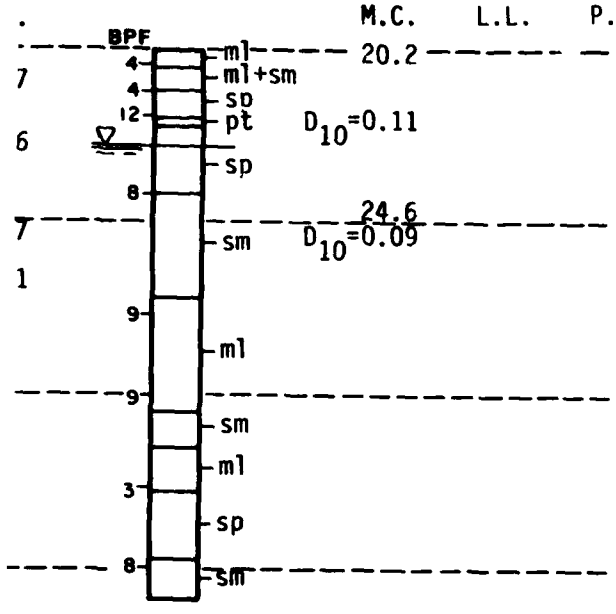
SOIL BORING LOCATIONS

ST. PAUL MINN. DISTRICT
FILE NO. M35.1-R-5/18 MARCH 1976

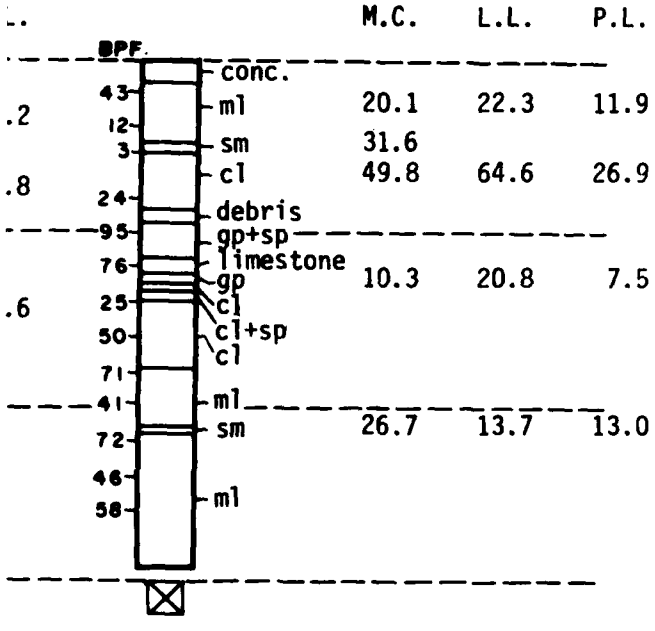
PLATE H-1


NO. 75-1M
DEPTH
BPF
M.C.
L.L.
P.L.
0
38
4
fill
ol+pt
cl
15.5
20.3
12.4
6
29.5
28.5
23.6
ml
10
9
cl
gp
sp
D_{10}=0.21
21
ml
15.0
12.6
20
9
D_{10}=0.09
11
sp
30
18
NO. 75-2M
BPF
M.C.
L.L.
P.L.
9
ml+ol
14.2
20.9
8.7
8
ml
7
17.1
29.2
11.6
7
16.7
22.3
12.7
11
14.5
21.5
10.1
cl
19
19.4
21
32
NO.
BPF
4
ml
4
ml+sm
sp
12
pt
sp
8
sm
9
ml
9
sm
ml
3
sp
8
sm
NO. 75-4M
DEPTH
BPF
M.C.
L.L.
P.L.
0
7
36.1
79.4
39.1
ol
sp
D_{10}=0.18
9
ml
25.2
28.9
19.5
10
8
D_{10}=0.14
sp
7
11
19.9
15.8
4.1
20
20
ml
16
sm
22
ml
sm
30
NO. 75-5M
BPF
M.C.
L.L.
P.L.
9
ml
pt+oh
25.4
59.2
25.2
10
14.7
20.4
9.8
5
12
cl
10.5
15.5
10.6
13
12
9
NO.
BPF
conc.
43
ml
12
sm
3
cl
24
debri
95
gp+sp
76
limes
gp
25
cl
cl+sp
50
cl
71
ml
41
sm
72
46
58
ml

NO. 75-3M



NO. 75-6M



BORING LEGEND

GW	Well graded gravels, little or no fines.
GP	Poorly graded gravels, little or no fines.
GM	Silty gravels.
GC	Clayey gravels, gravel sand clay mixtures.
SW	Well graded sands, little or no fines.
SP	Poorly graded sands, little or no fines.
SM	Silty sands.
SC	Clayey sands.
ML	Inorganic silts, liquid limit less than 50.
MH	Inorganic silts, liquid limit greater than 50.
CL	Inorganic clays, low to medium plasticity, liquid limit less than 50.
CH	Inorganic clays, high plasticity-liquid limit greater than 50.
OL	Organic silts or clays, low plasticity.
OH	Organic silts or clays, liquid limit greater than 50.
PT	Peat.
▽	Groundwater level.
⊠	No groundwater reading.

NOTES

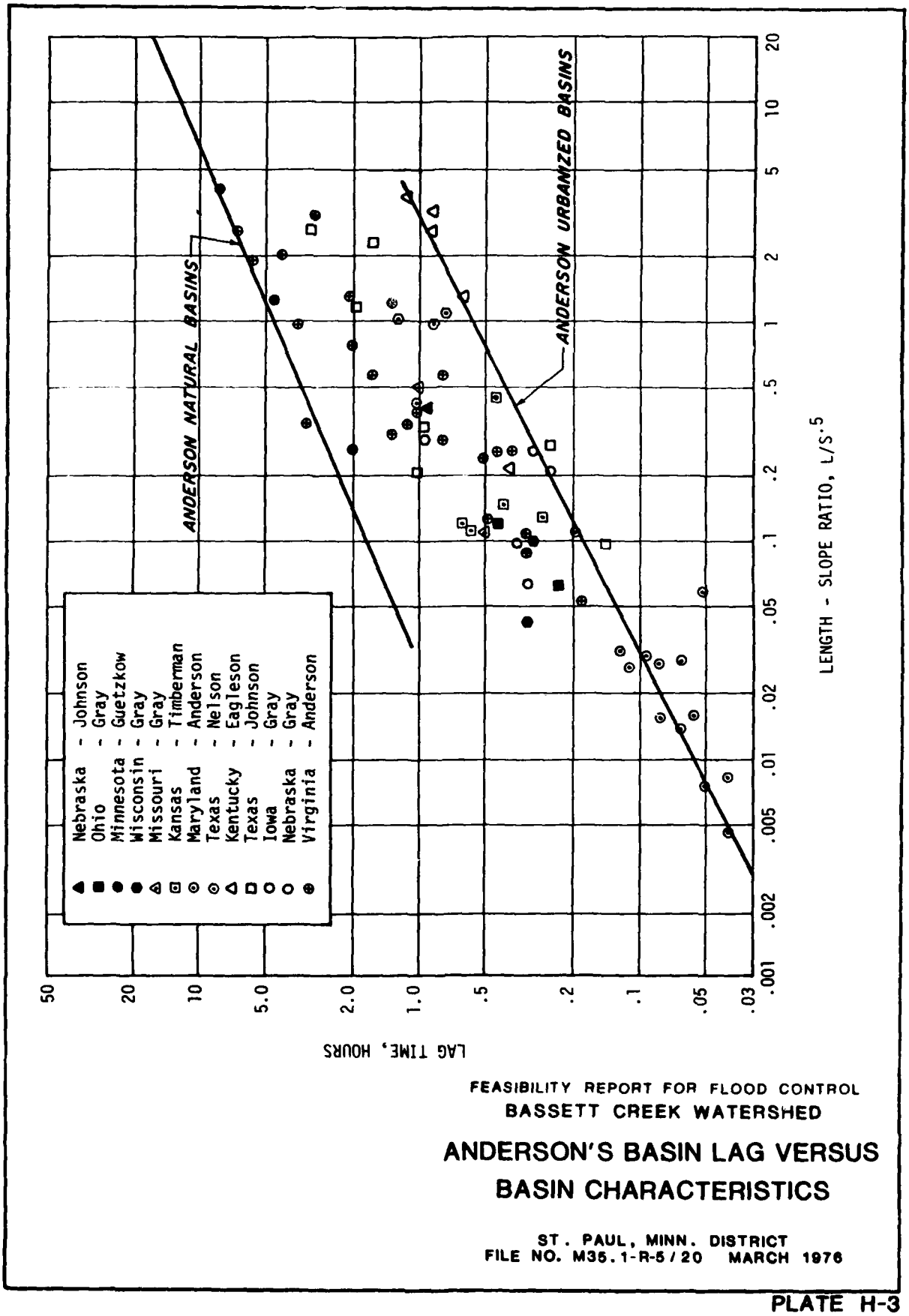
1. The legend represents only the basic soils. To complete the classification, pertinent information is added to the right of the boring log.
2. Moisture Content (MC) — The natural moisture content in percent of dry weight is shown to the left of the boring log.
3. Atterberg Limits — Liquid limit (LL) and plastic limit (PL) are shown to the right of the boring log.
4. D_{10} — The grain size in millimeters, of which 10% of the soil sample is finer, is shown to the right of the boring log.
5. Blow Counts (BPF) — Blow counts are shown to the left of the boring logs and are the number of blows necessary to drive a 1-3/8" x 2" sampler a distance of 12 inches, using a 140 lb. hammer and a 30 inch drop.

FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

BORING LOGS

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/19 MARCH 1976

PLATE H-2



FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

ANDERSON'S BASIN LAG VERSUS BASIN CHARACTERISTICS

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/20 MARCH 1976

PLATE H-3

FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

BASIN LAG VERSUS BASIN CHARACTERISTICS

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/21 MARCH 1976

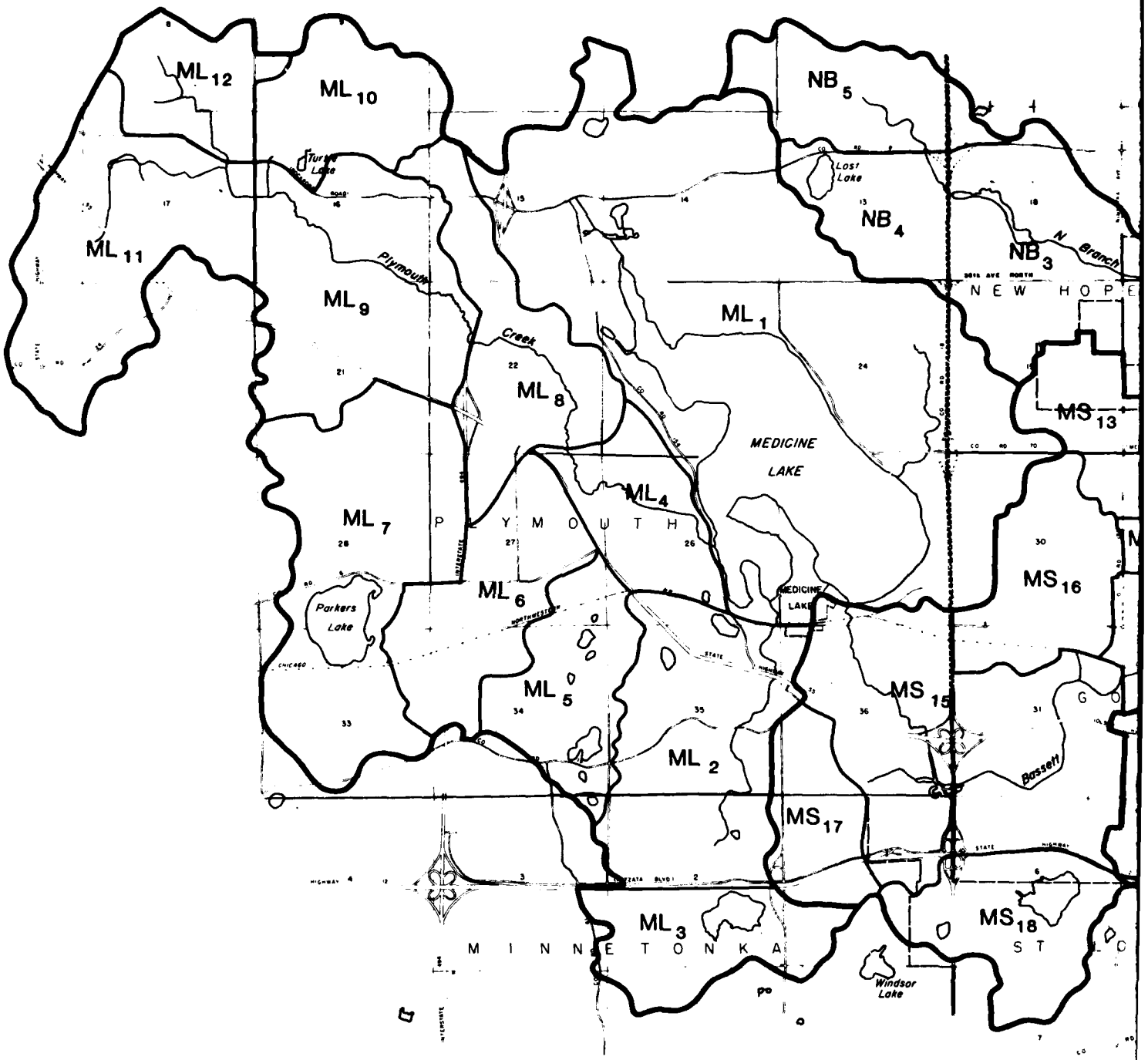
PLATE H-4

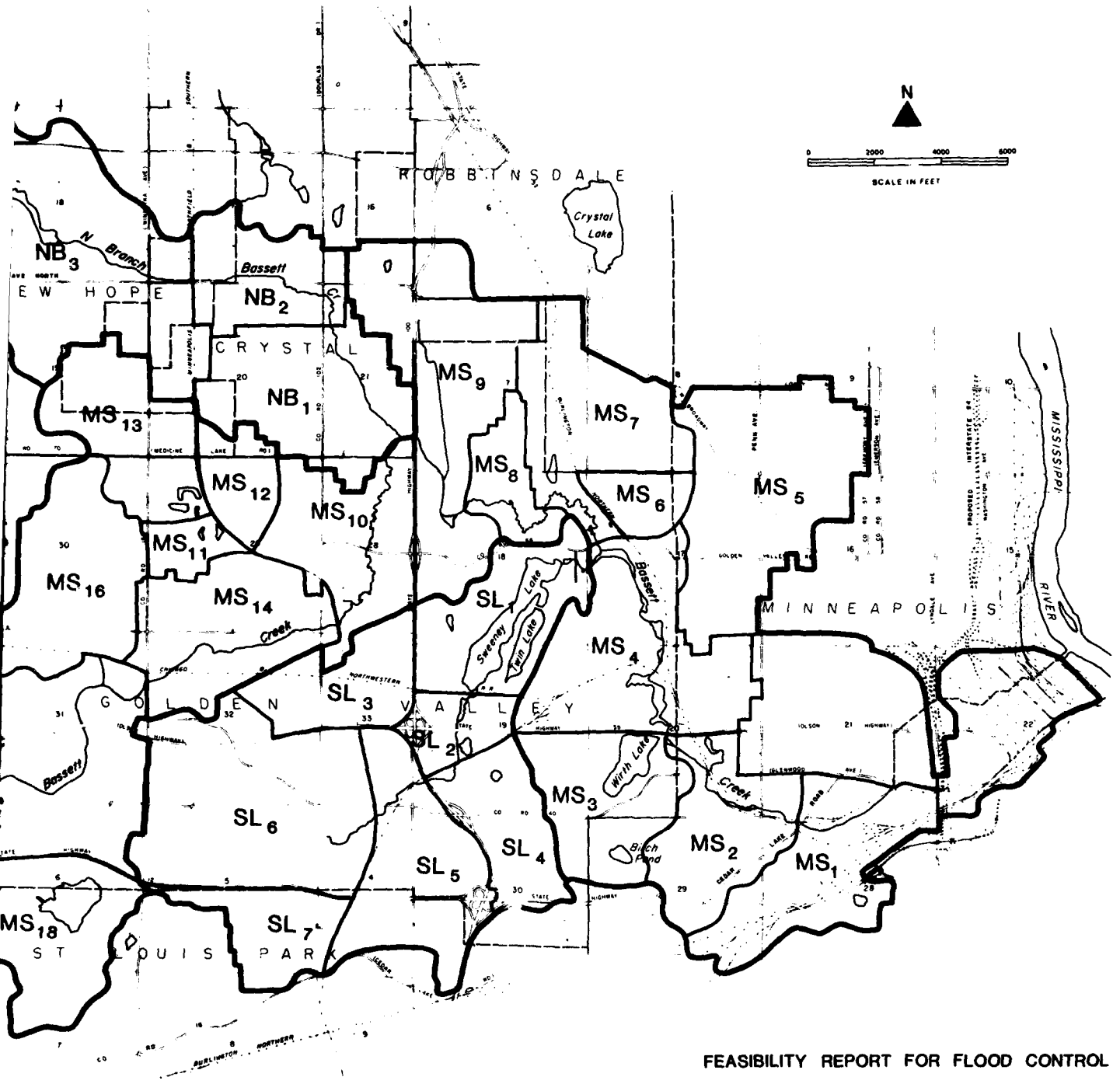
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

BASIN LAG VERSUS UNIT HYDROGRAPH PEAK

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/22 MARCH 1976

PLATE H-5


ML 12
ML 10
NB 5
Turtle Lake
Lost Lake
NB 4
NB 3
N Branch
ML 11
Plymouth
ML 9
NEW HOPE
ML 1
Creek
ML 8
MS 13
MEDICINE
LAKE
ML 4
ML 7
PLYMOUTH
MS 16
Parkers Lake
ML 6
MEDICINE LAKE
ML 5
MS 15
ML 2
Bassett
MS 17
ML 3
MS 18
MINNETONKA
Windsor Lake



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

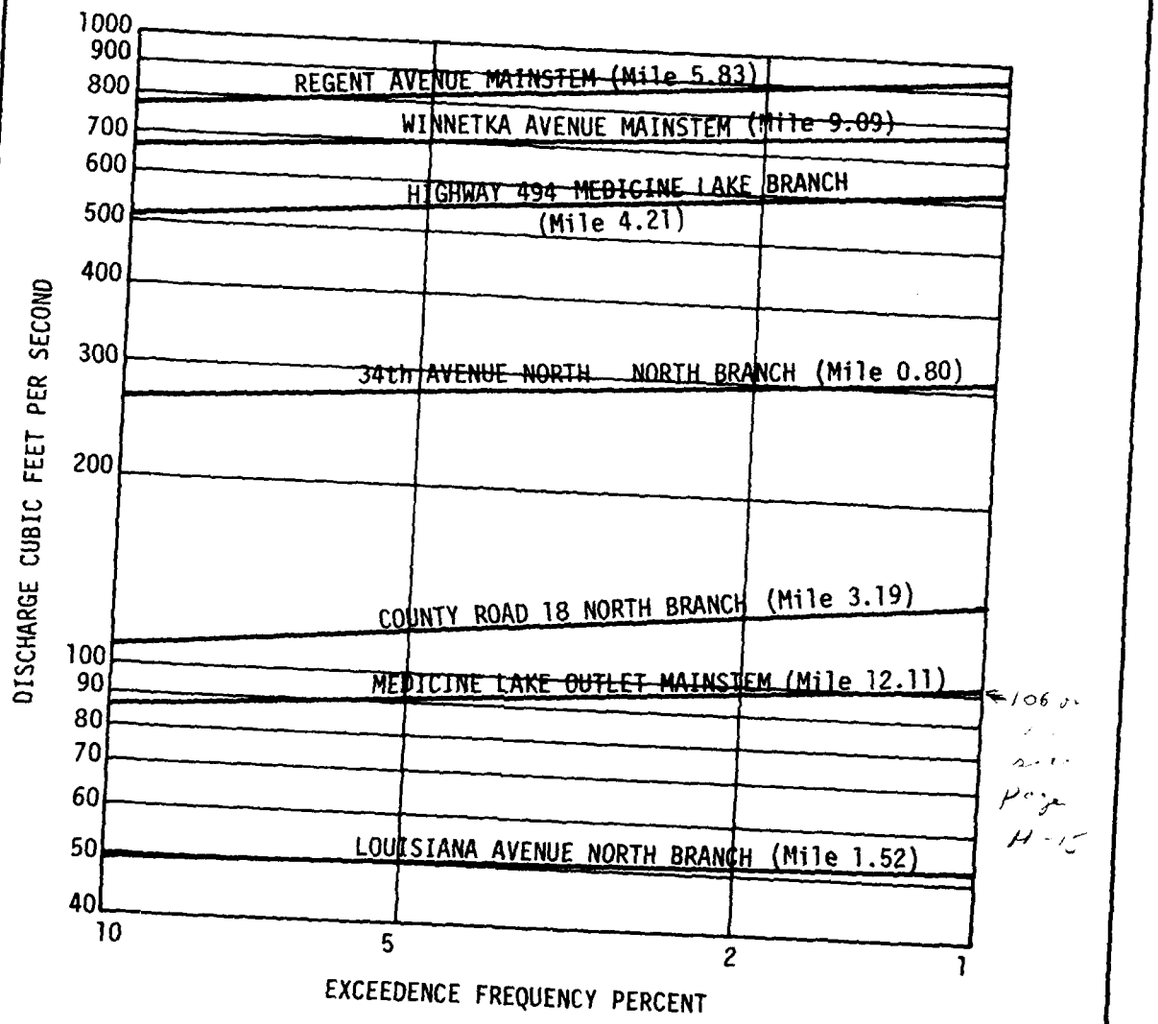
SUBWATERSHED DIVIDES

2

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/23 MARCH 1976

PLATE H-6

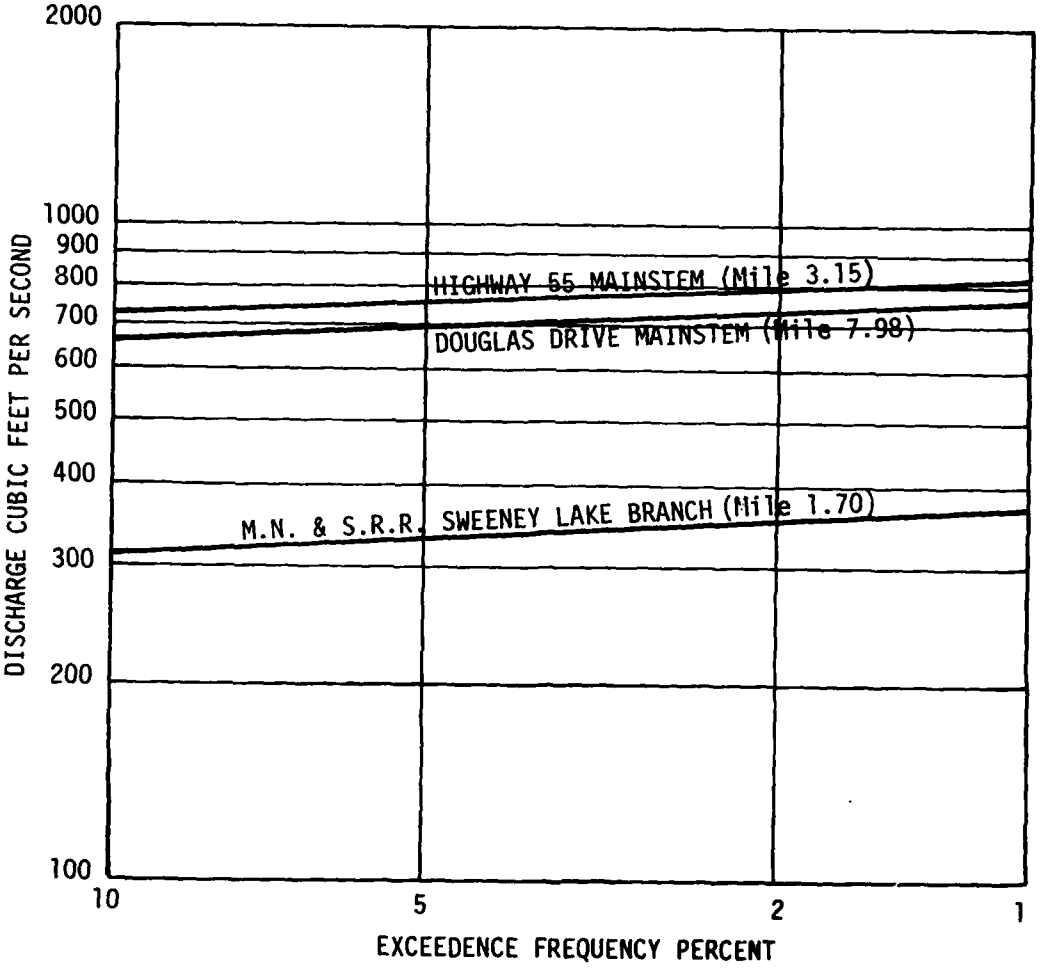


FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

DISCHARGE FREQUENCY RELATIONSHIPS

ST. PAUL, MINN. DISTRICT
FILE NO. MSS.1-R-5/24 MARCH 1976

PLATE H-7

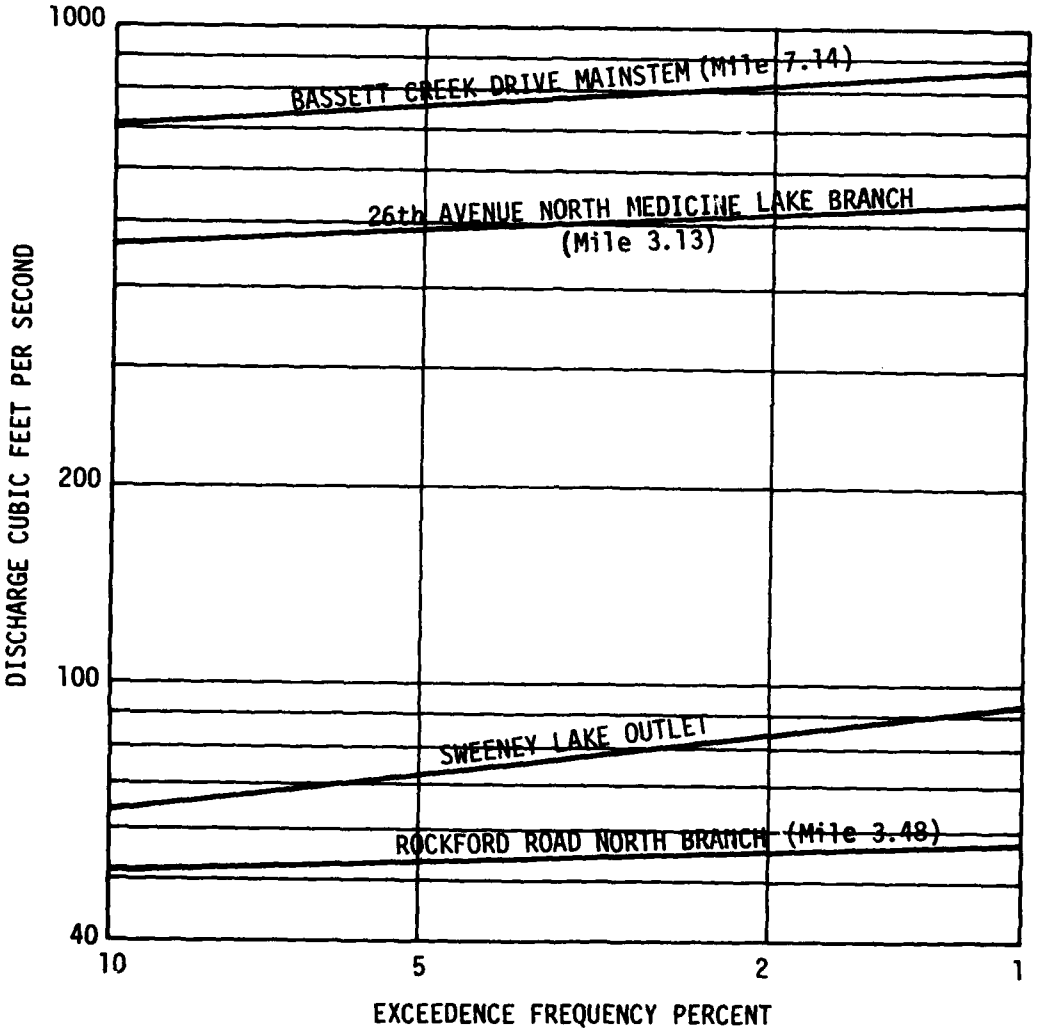


FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

DISCHARGE FREQUENCY RELATIONSHIPS

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/25 MARCH 1976

PLATE H-8

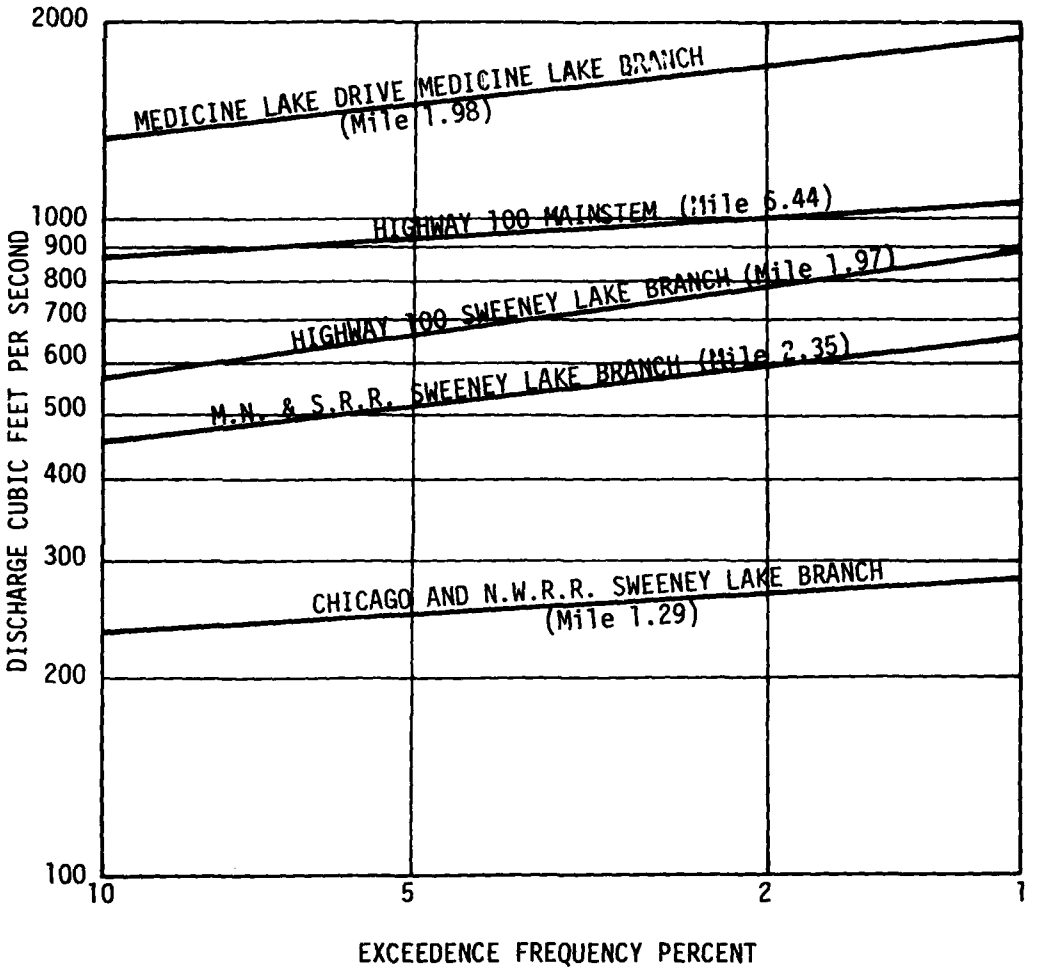


FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

DISCHARGE FREQUENCY RELATIONSHIPS

ST. PAUL, MINN. DISTRICT
FILE NO. M 35.1-R-5/26 MARCH 1976

PLATE H-9

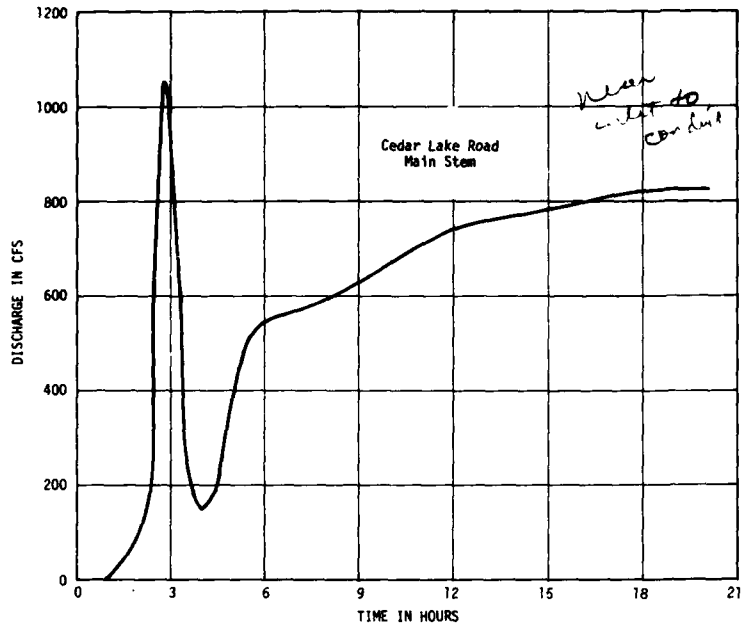


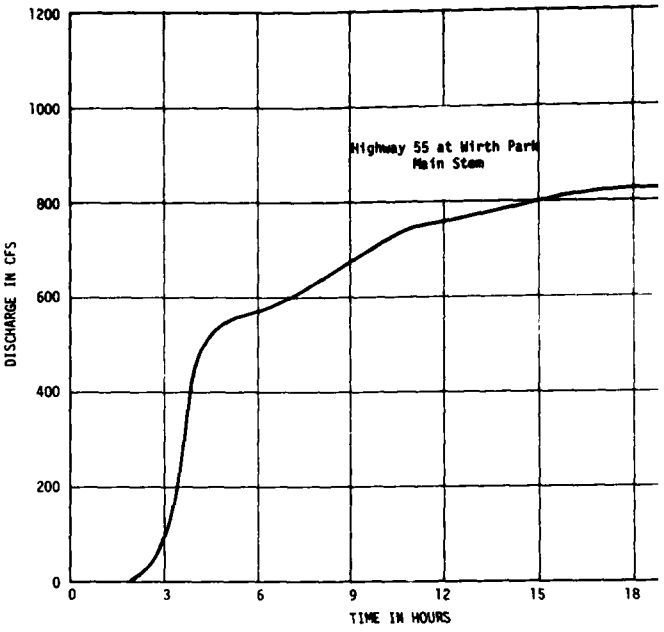
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

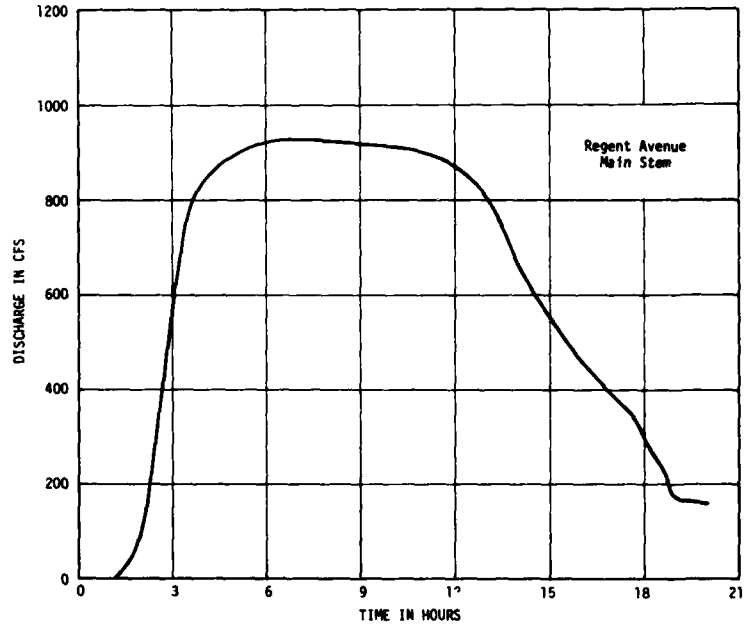
DISCHARGE FREQUENCY RELATIONSHIPS

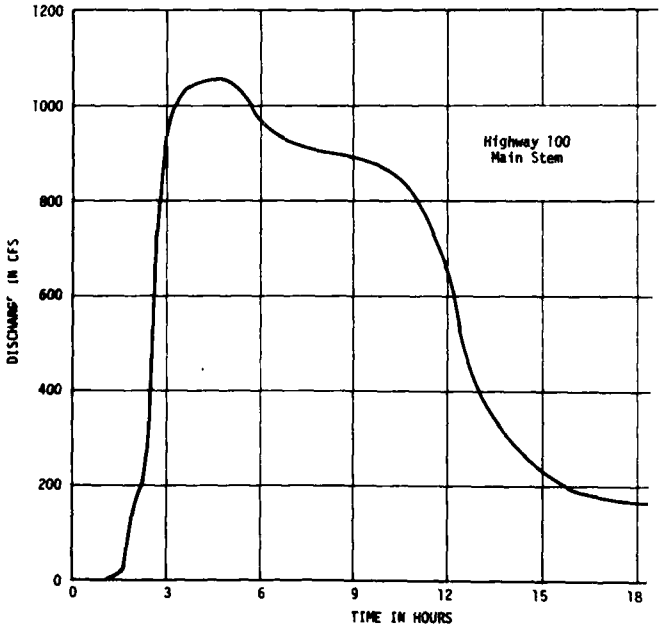
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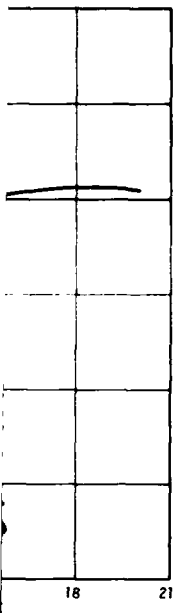
PLATE H-10

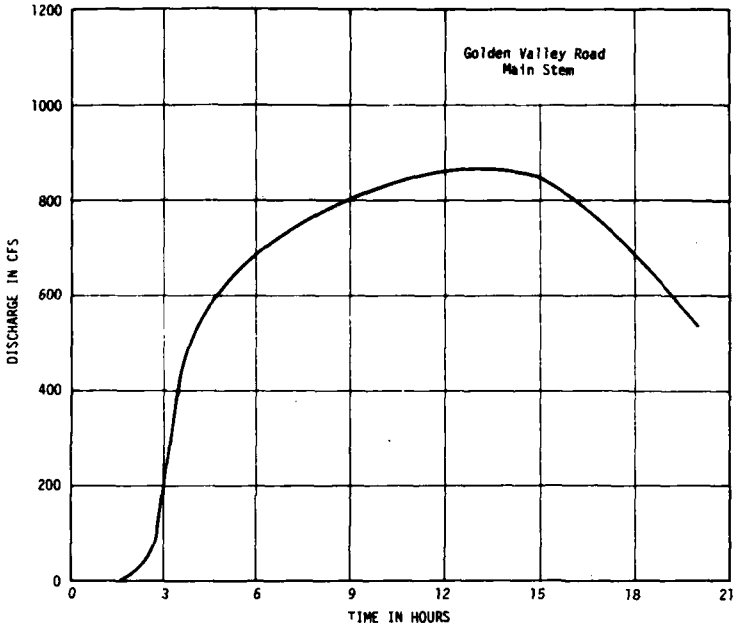

Cedar Lake Road
Main Stem
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15
18
21

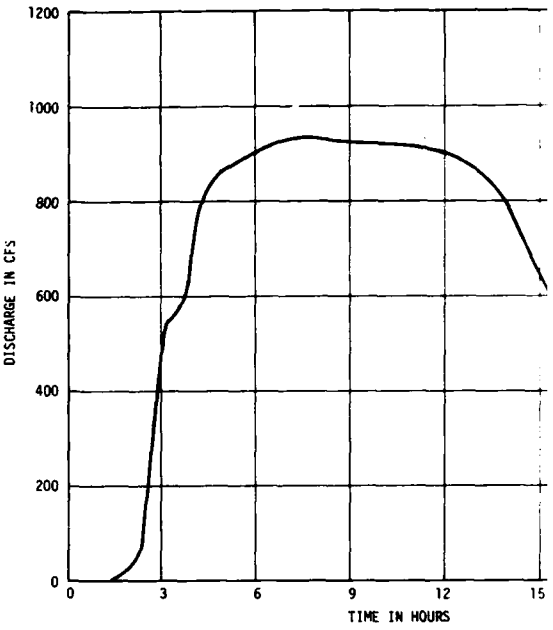

Highway 55 at Wirth Park
Main Stem
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15
18

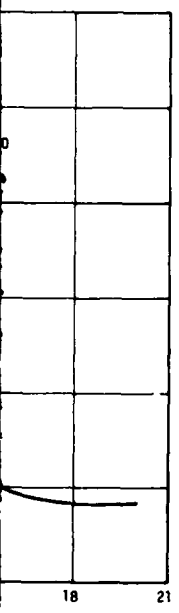

Regent Avenue
Main Stem
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
15
18
21

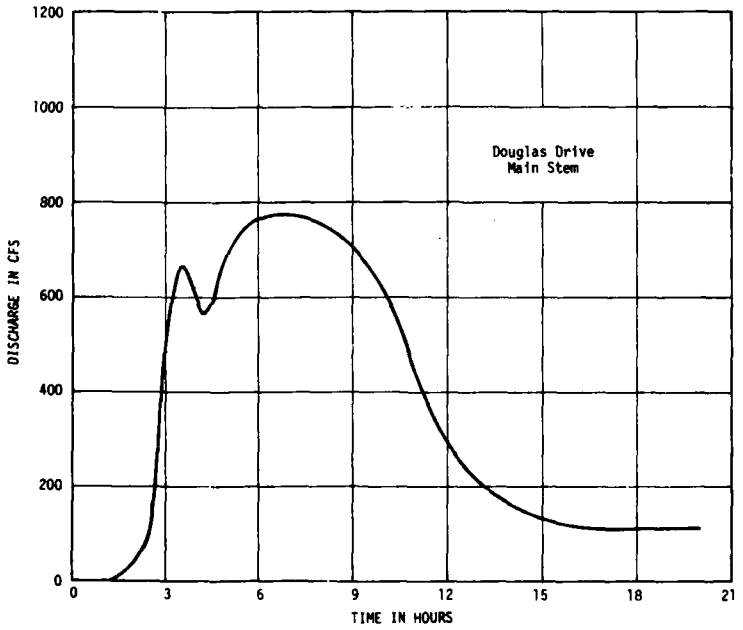

Highway 100
Main Stem
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15
18

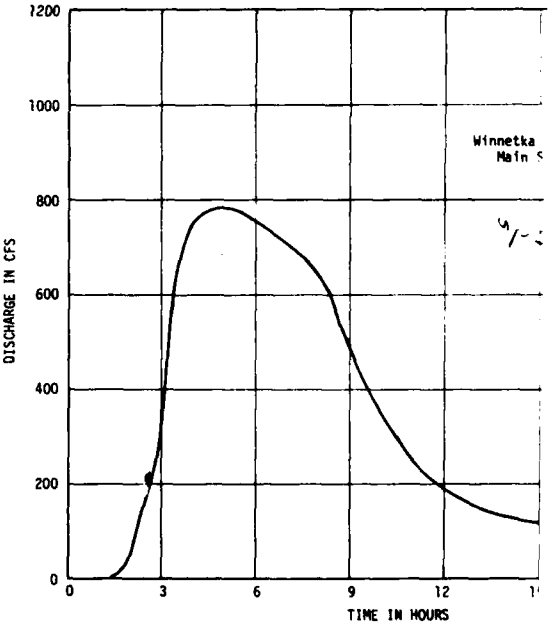

18
21

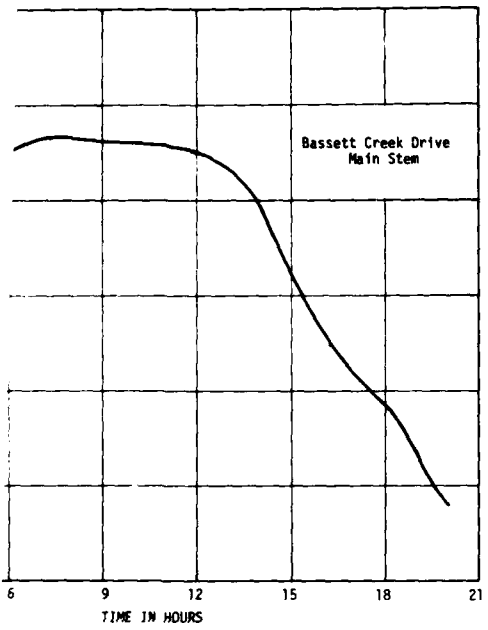

Golden Valley Road
Main Stem
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15
18
21

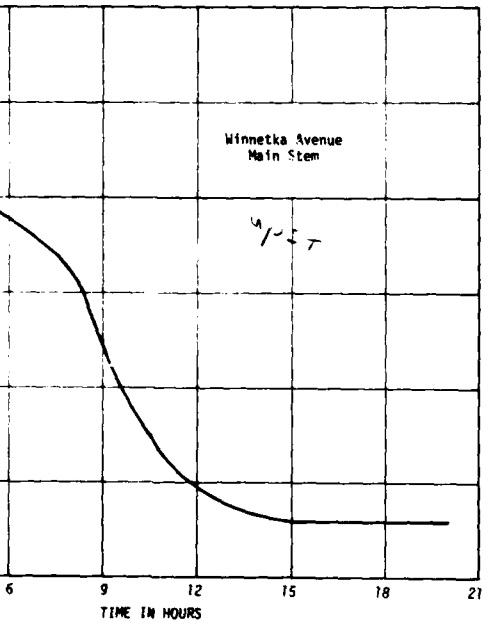

DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15


18
21


Douglas Drive
Main Stem
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15
18
21


Winnetka
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12





FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

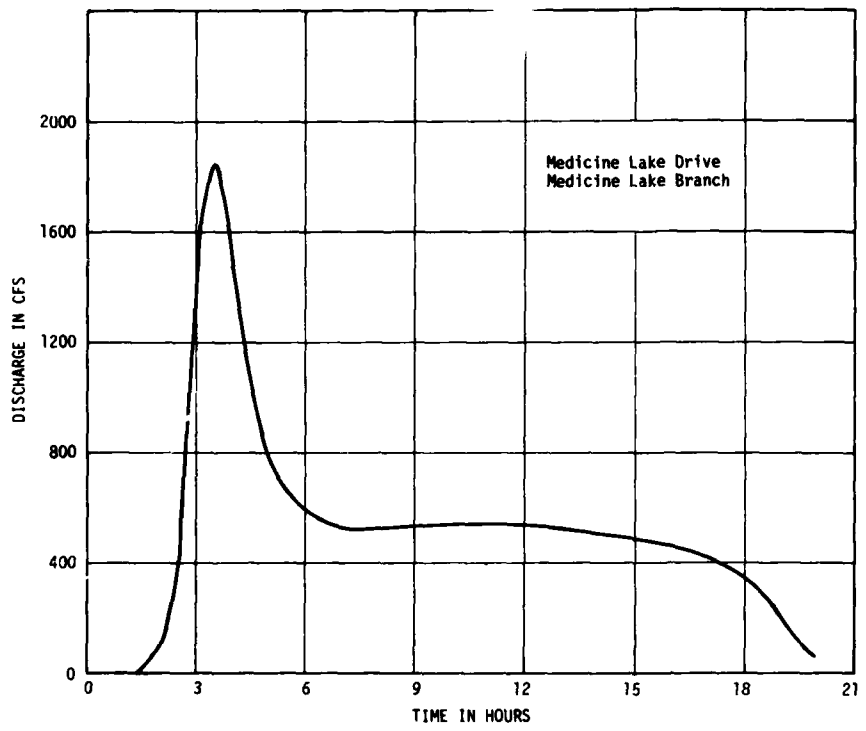
100 YEAR FLOOD HYDROGRAPHS

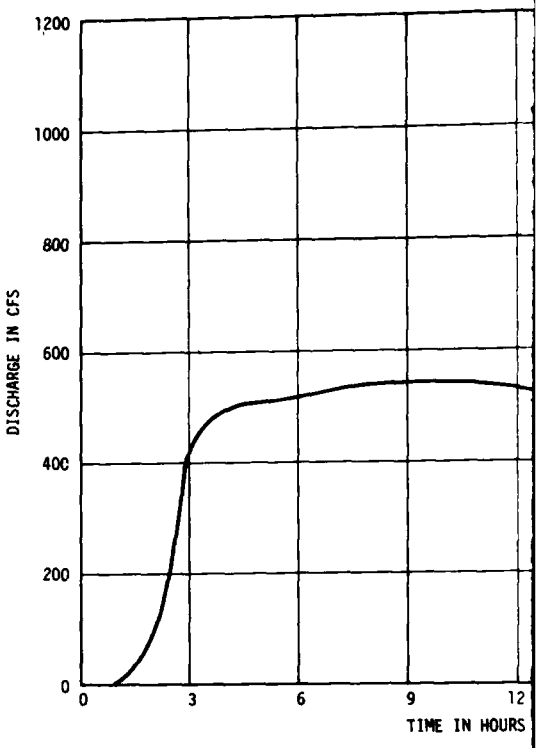
ST. PAUL MINN. DISTRICT

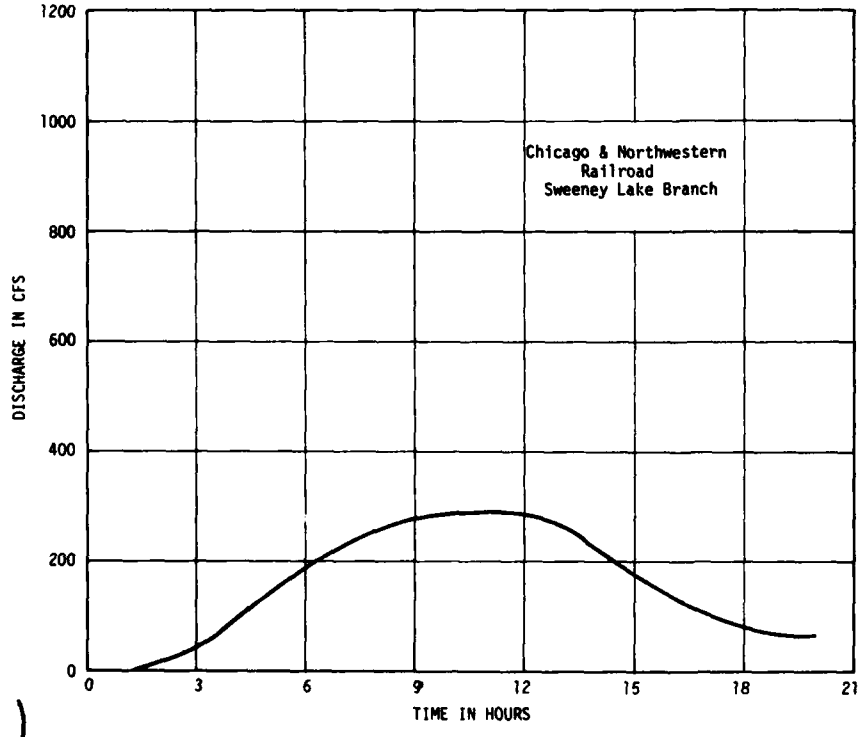
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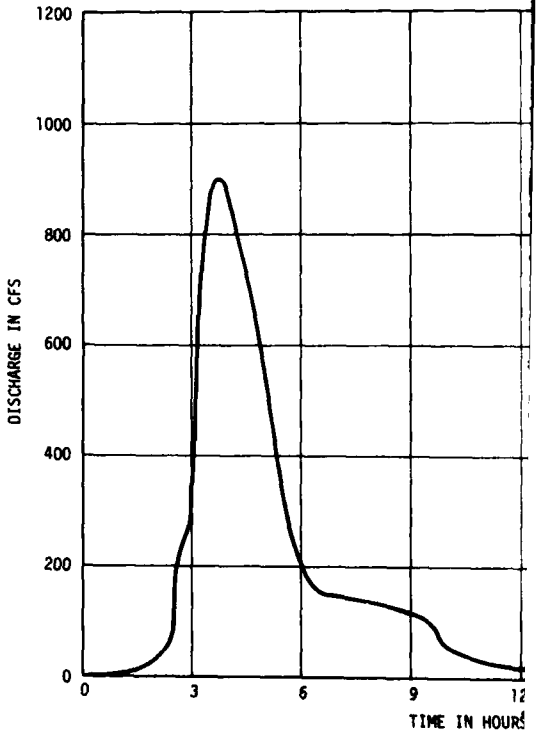
PLATE H-11

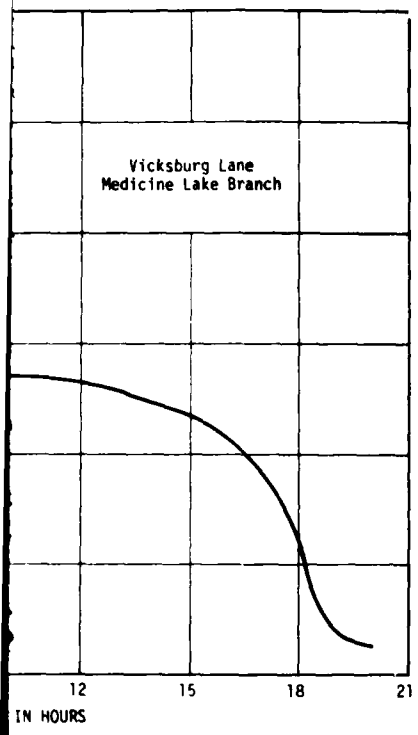
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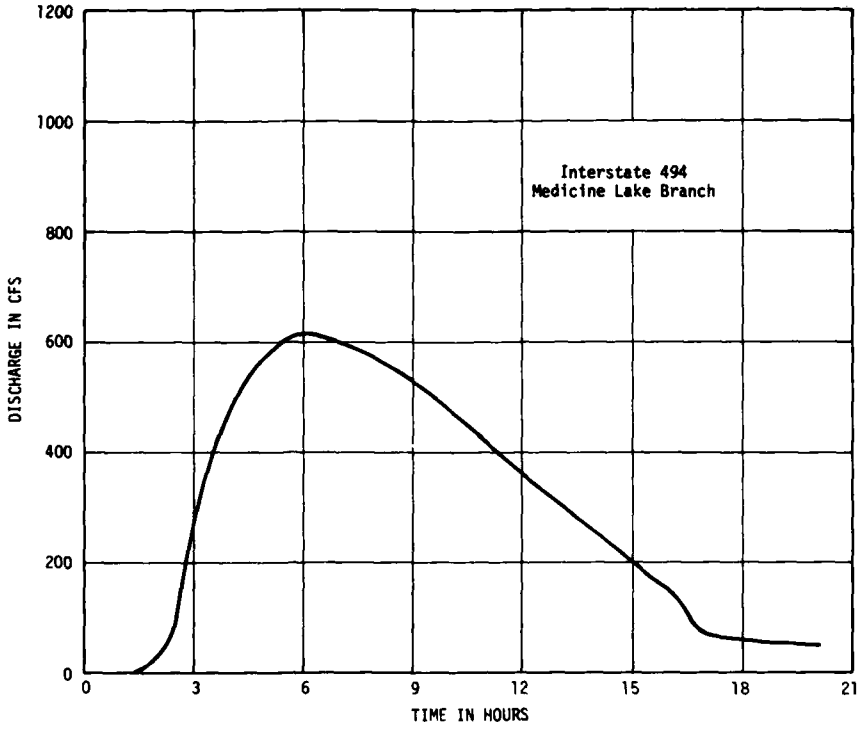

Medicine Lake Drive
Medicine Lake Branch
DISCHARGE IN CFS
TIME IN HOURS
0
400
800
1200
1600
2000
0
3
6
9
12
15
18
21

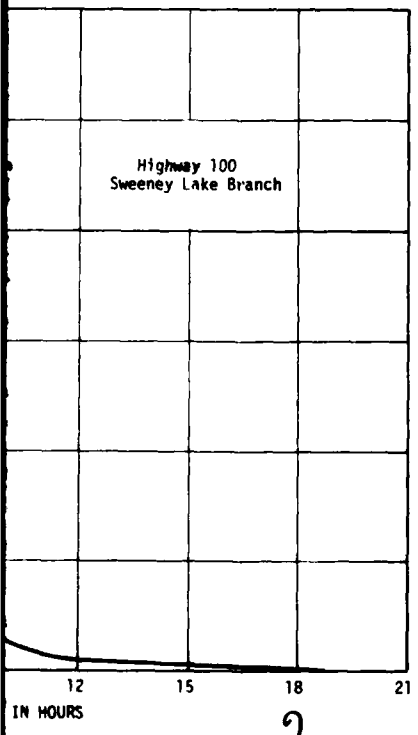

DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12

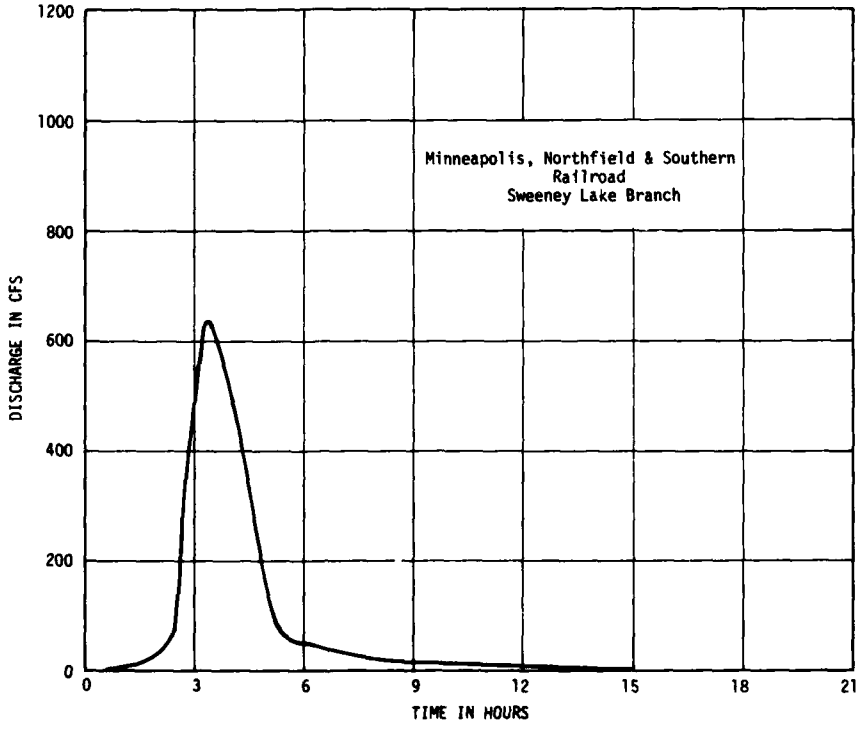

Chicago & Northwestern
Railroad
Sweeney Lake Branch
DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12
15
18
21


DISCHARGE IN CFS
TIME IN HOURS
0
200
400
600
800
1000
1200
0
3
6
9
12

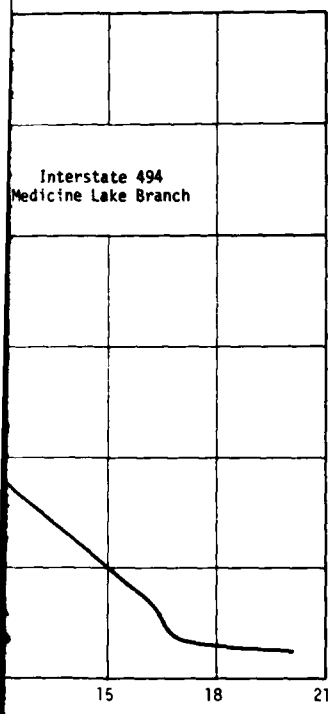

Vicksburg Lane
Medicine Lake Branch
12
15
18
21
IN HOURS

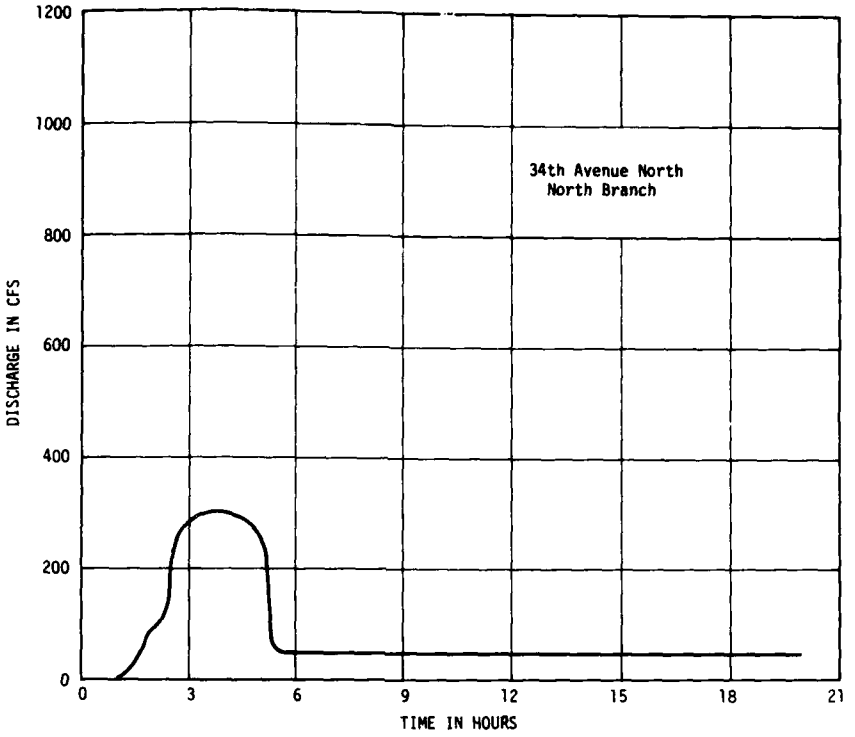

Interstate 494
Medicine Lake Branch
DISCHARGE IN CFS
1200
1000
800
600
400
200
0
0
3
6
9
12
15
18
21
TIME IN HOURS

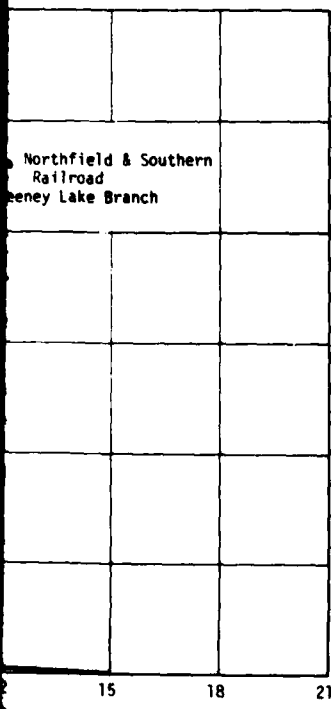

Highway 100
Sweeney Lake Branch
12
15
18
21
IN HOURS


Minneapolis, Northfield & Southern
Railroad
Sweeney Lake Branch
DISCHARGE IN CFS
1200
1000
800
600
400
200
0
0
3
6
9
12
15
18
21
TIME IN HOURS

2







FEASIBILITY REPORT FOR FLOOD CONTROL

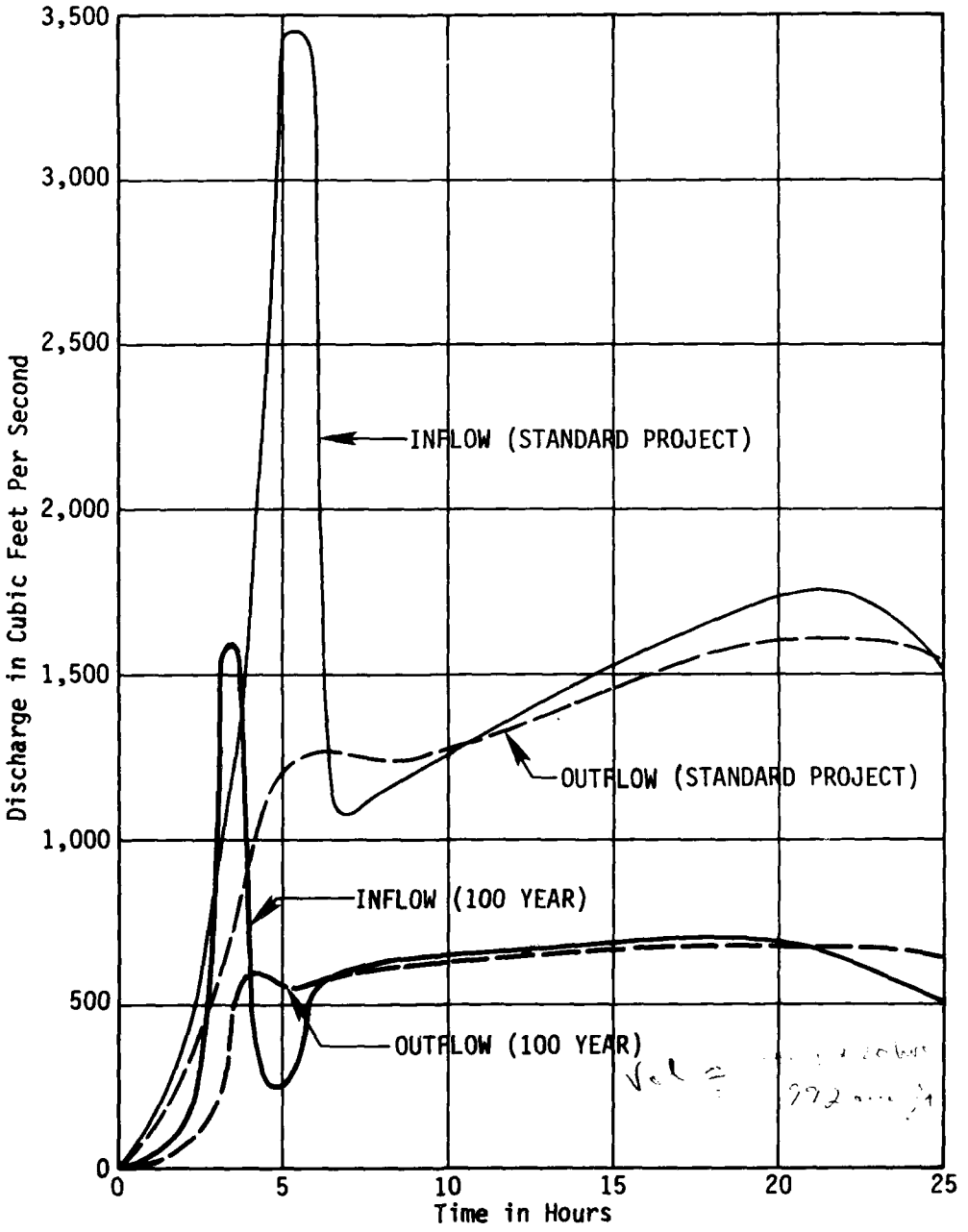
BASSETT CREEK WATERSHED

100 YEAR FLOOD HYDROGRAPHS

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/29 MARCH 1976

PLATE H-12



FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

FLOOD HYDROGRAPHS

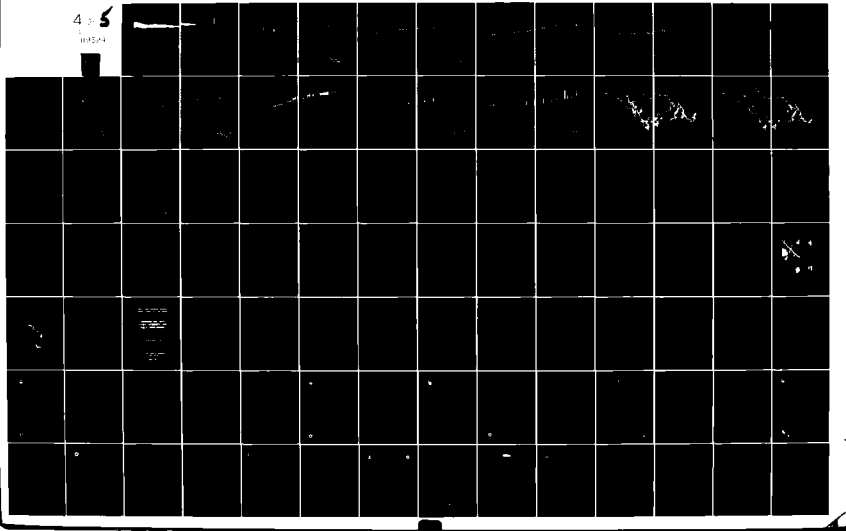
CONDUIT AREA

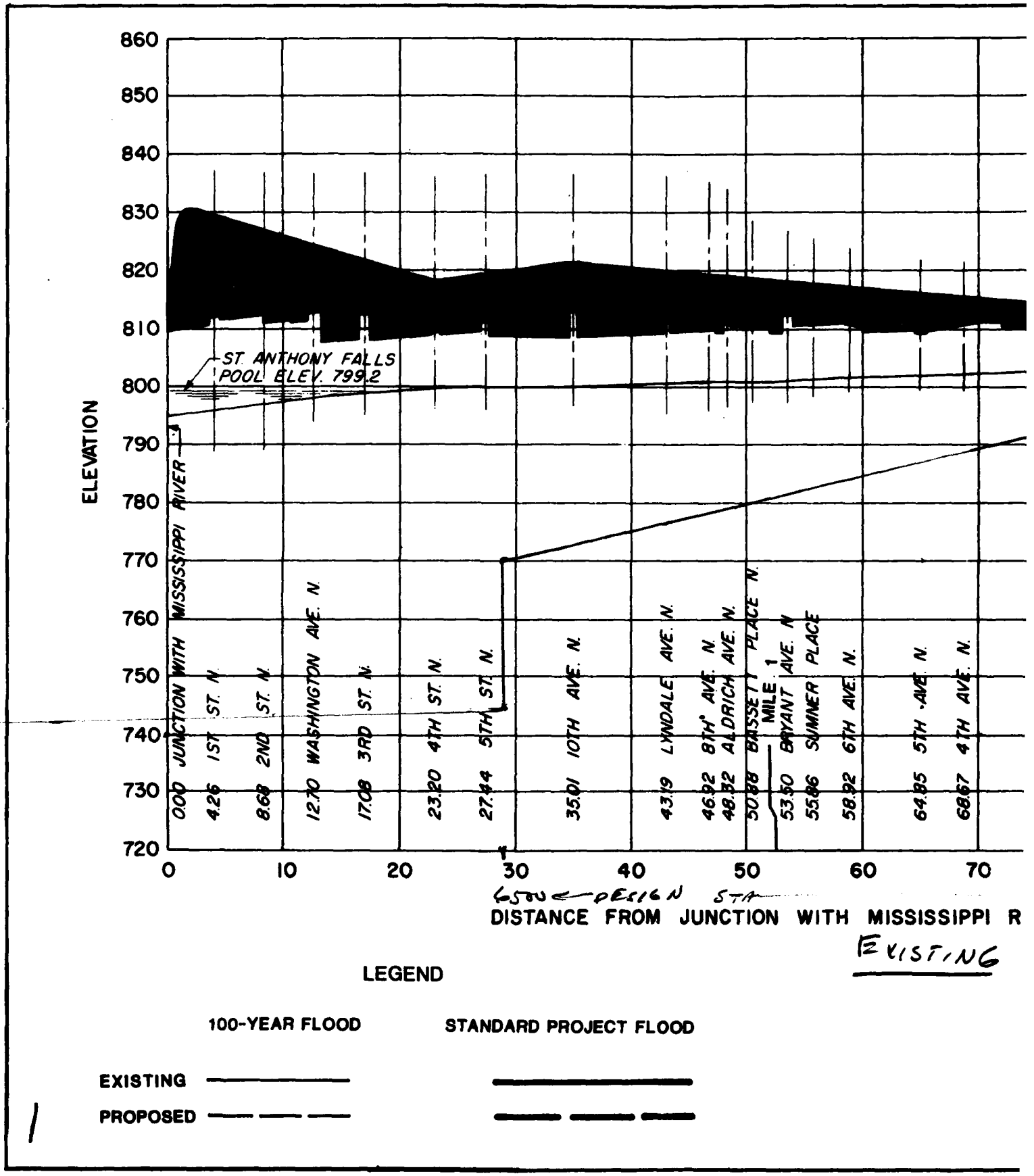
ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/30 MARCH 1976

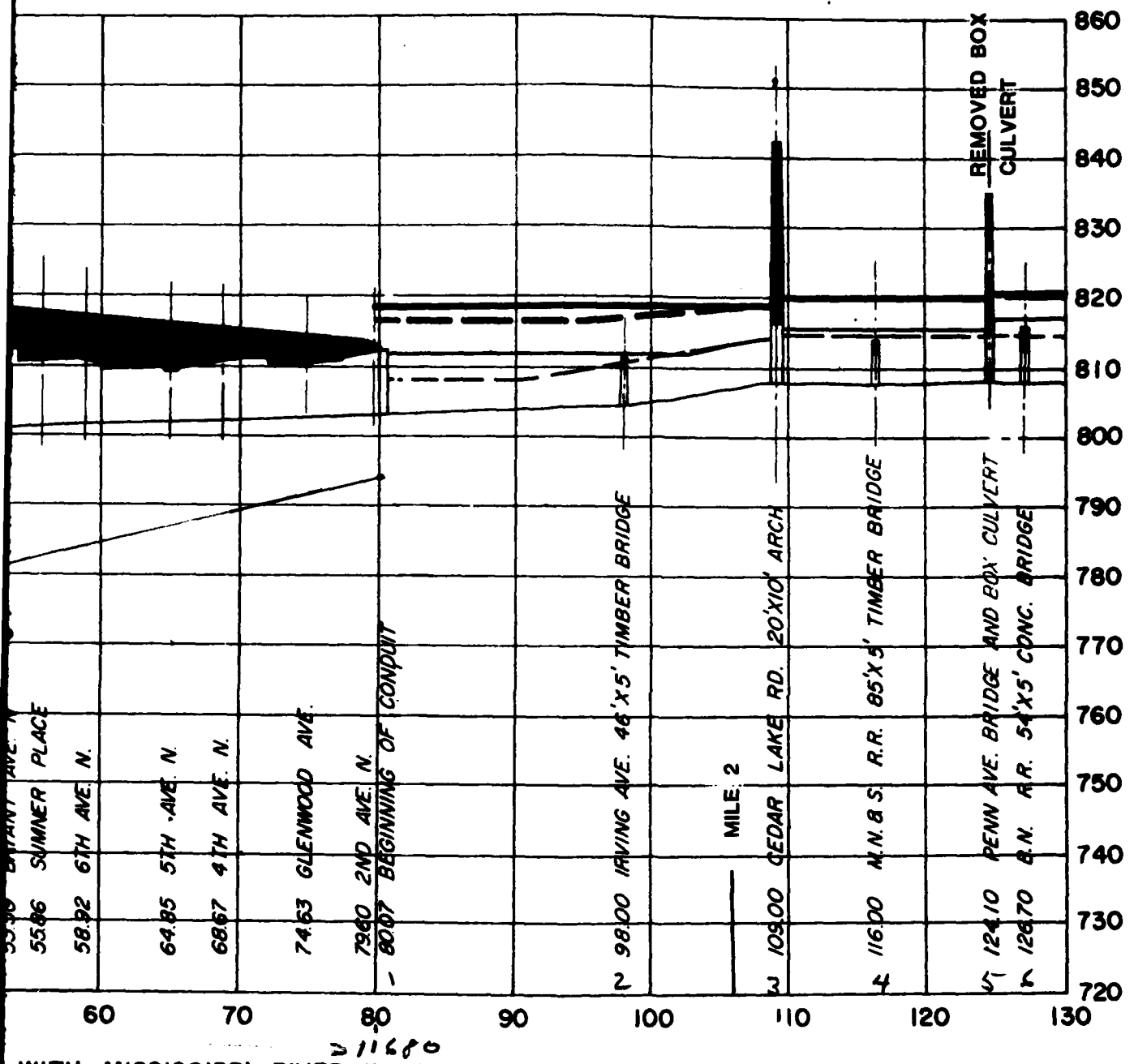
PLATE H-13

AD-A119 394 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
BASSETT CREEK WATERSHED, HENNEPIN COUNTY, MINNESOTA. FEASIBILIT--ETC(U)
MAR 76

UNCLASSIFIED NL




860
850
840
830
820
810
800
790
780
770
760
750
740
730
720
ELEVATION
ST. ANTHONY FALLS
POOL ELEV. 799.2
0.00 JUNCTION WITH MISSISSIPPI RIVER
4.26 1ST ST. N.
8.68 2ND ST. N.
12.70 WASHINGTON AVE. N.
17.08 3RD ST. N.
23.20 4TH ST. N.
27.44 5TH ST. N.
35.01 10TH AVE. N.
43.19 LYNDALE AVE. N.
46.92 8TH AVE. N.
48.32 ALDRICH AVE. N.
50.88 BASSETT PLACE N.
53.50 MILE 1
53.50 BRYANT AVE. N.
55.86 SUMNER PLACE
58.92 6TH AVE. N.
64.85 5TH AVE. N.
68.67 4TH AVE. N.
0
10
20
30
40
50
60
70
650 ← DESIGN STA
DISTANCE FROM JUNCTION WITH MISSISSIPPI R
EXISTING
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



WITH MISSISSIPPI RIVER IN HUNDREDS OF FEET

EXISTING

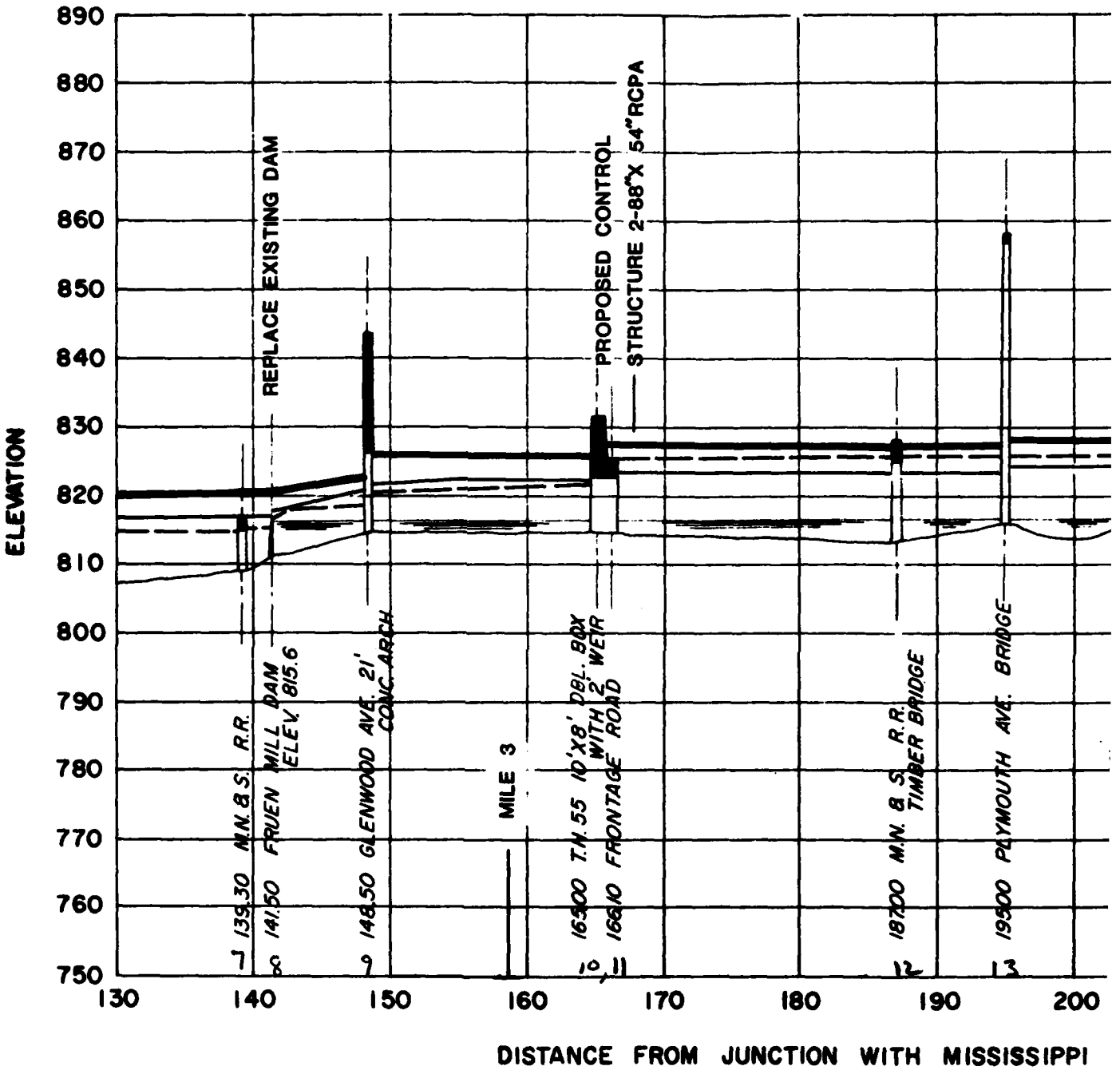
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

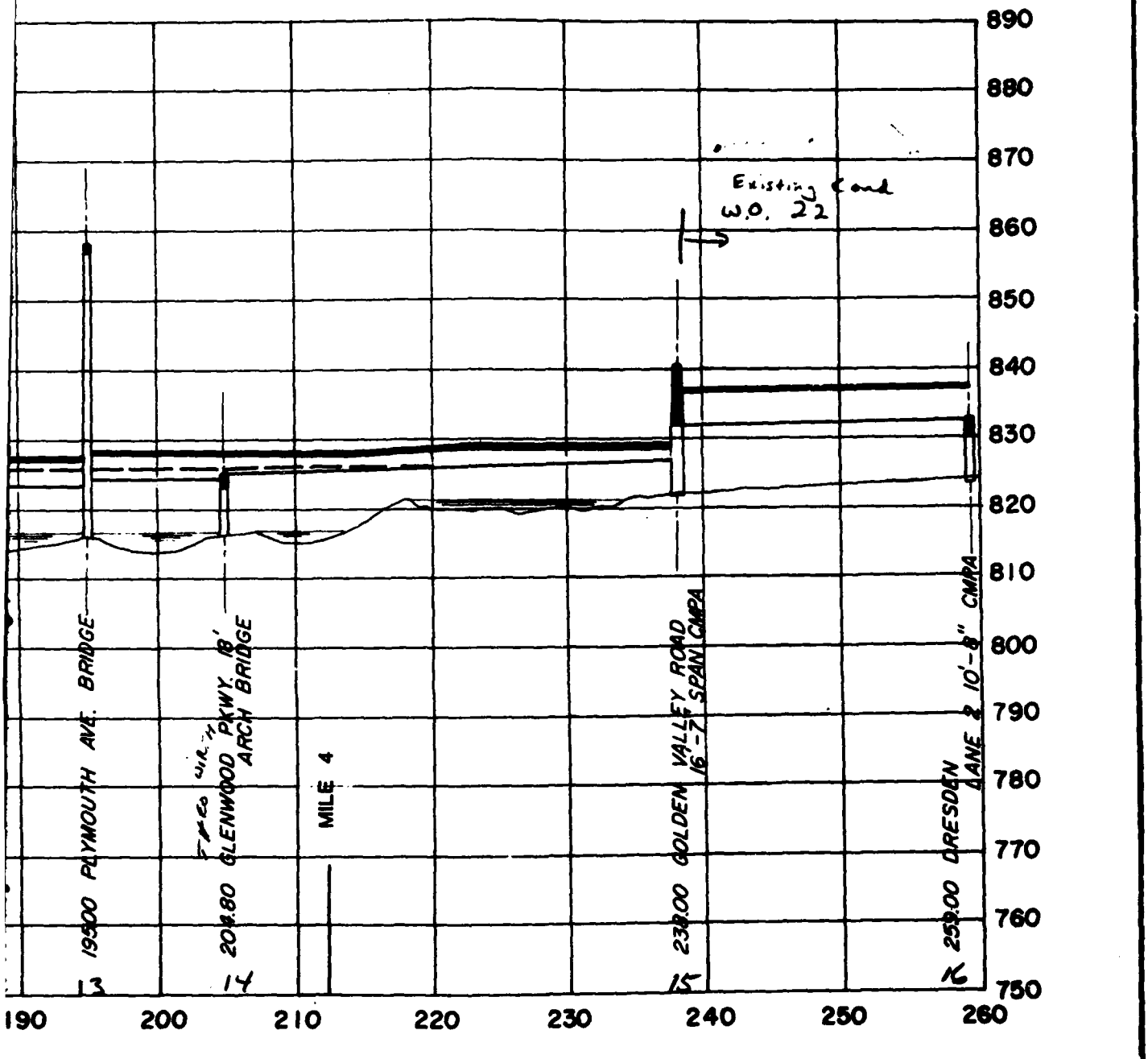
EXISTING AND PROPOSED FLOOD PROFILES MAIN STEM

2

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/31 MARCH 1976

PLATE H-14


890
880
870
860
850
840
830
820
810
800
790
780
770
760
750
ELEVATION
130
140
150
160
170
180
190
200
DISTANCE FROM JUNCTION WITH MISSISSIPPI
REPLACE EXISTING DAM
PROPOSED CONTROL
STRUCTURE 2-88"X 54"RCPA
139.30 M.N. & S. R.R.
141.50 FRUEN MILL DAM ELEV 815.6
148.50 GLENWOOD AVE. 21' CONC. ARCH
MILE 3
165.00 T.H. 55 10'X8' DBL. BOX WITH 2' WEIR
166.10 FRONTAGE ROAD
187.00 M.N. & S. R.R. TIMBER BRIDGE
195.00 PLYMOUTH AVE. BRIDGE
8
9
10, 11
12
13
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



MISSISSIPPI RIVER IN HUNDREDS OF FEET

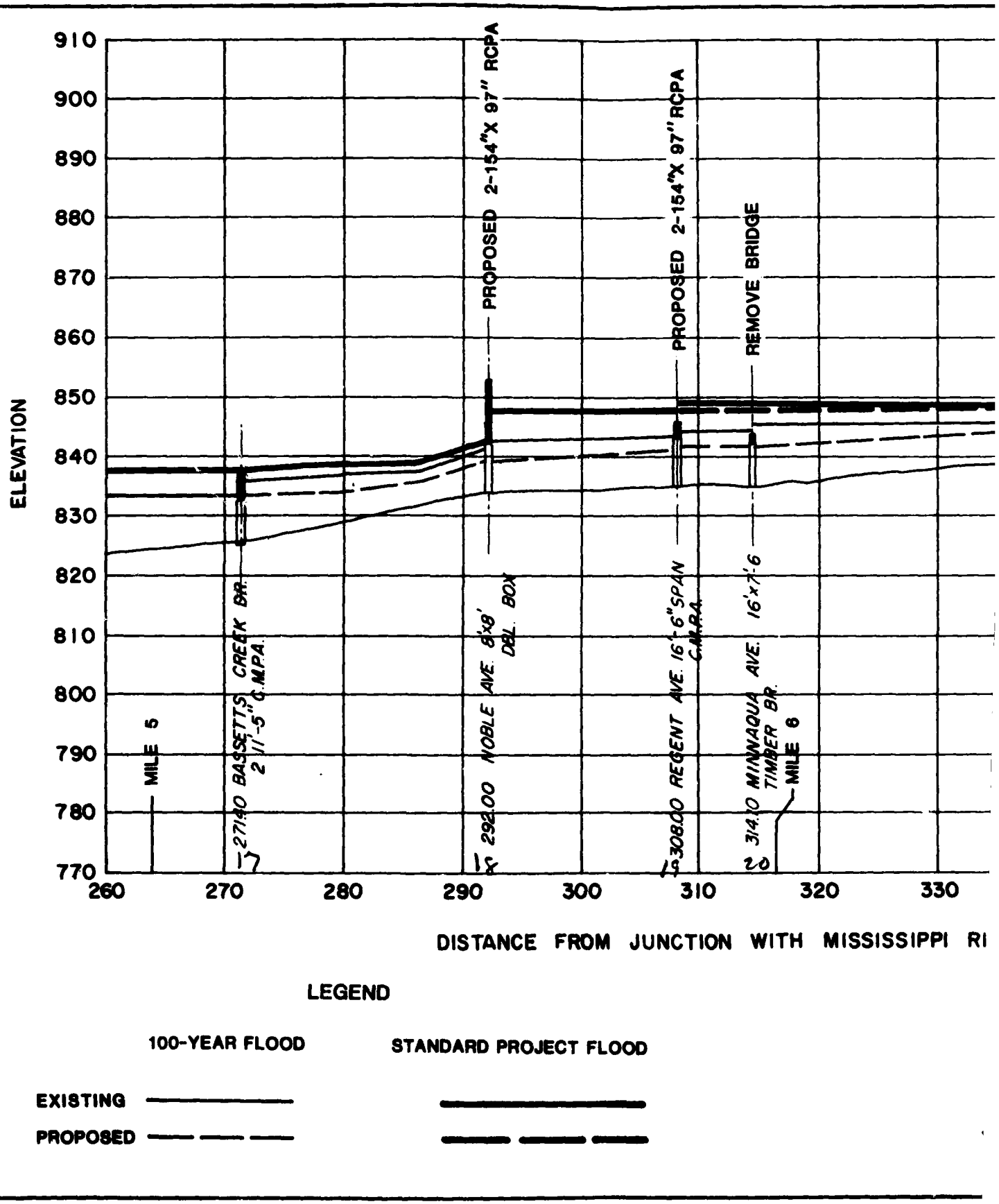
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

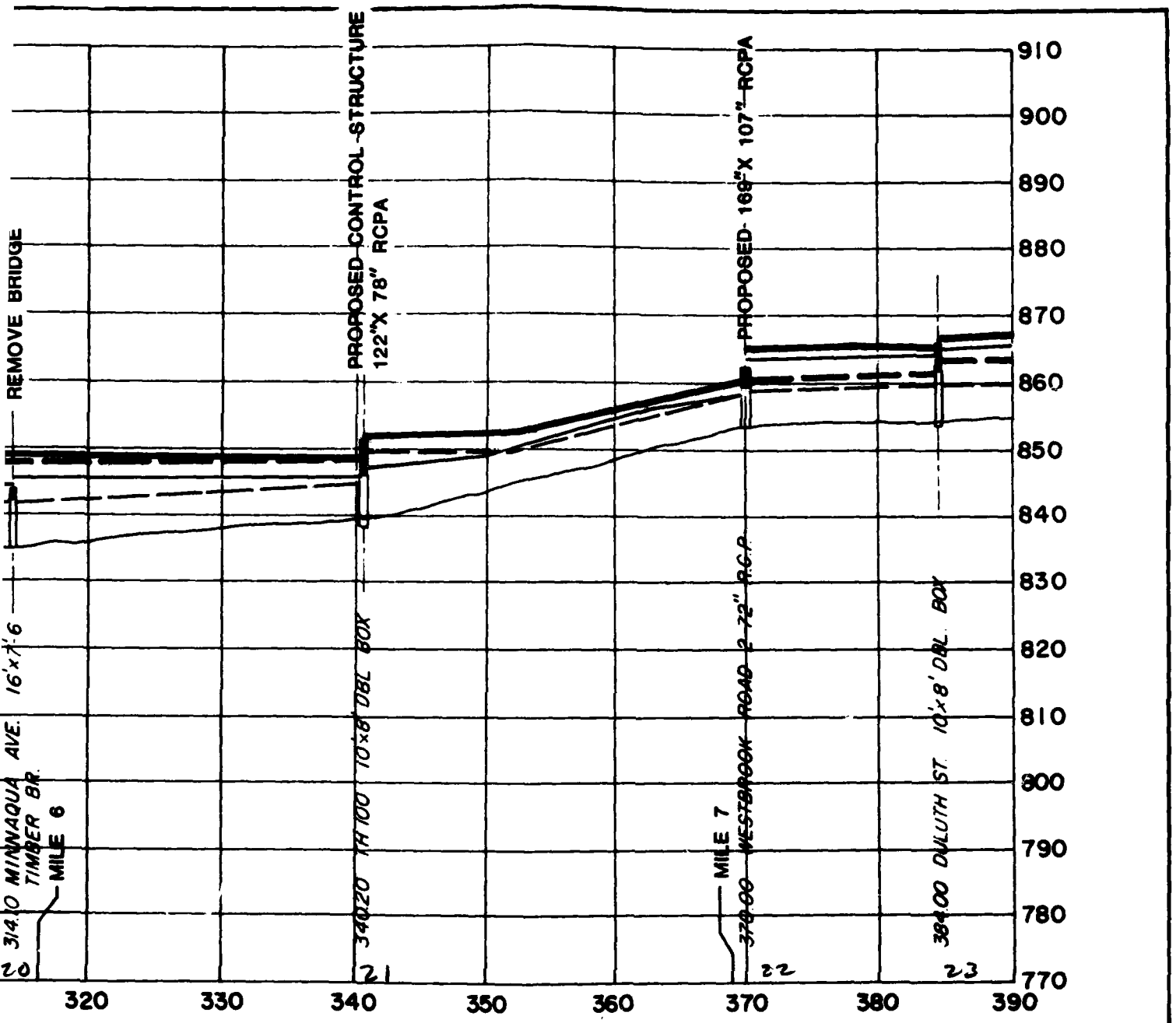
EXISTING AND PROPOSED FLOOD PROFILES MAIN STEM

2

ST. PAUL, MINN. DISTRICT
FILE NO. M 36.1-R-5/32 MARCH 1976

PLATE H-15


910
900
890
880
870
860
850
840
830
820
810
800
790
780
770
ELEVATION
260
270
280
290
300
310
320
330
DISTANCE FROM JUNCTION WITH MISSISSIPPI RI
MILE 5
2740 BASSETTS CREEK BR. 2 11'-5" C.M.P.A.
2920.00 NOBLE AVE. 8'x8' DBL. BOX
PROPOSED 2-154"X 97" RCPA
3080.00 REGENT AVE. 16'-6"SPAN C.M.P.A.
PROPOSED 2-154"X 97" RCPA
REMOVE BRIDGE
3140 MINNAQUA AVE. 16'x7'-6 TIMBER BR.
MILE 6
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



WITH MISSISSIPPI RIVER IN HUNDREDS OF FEET

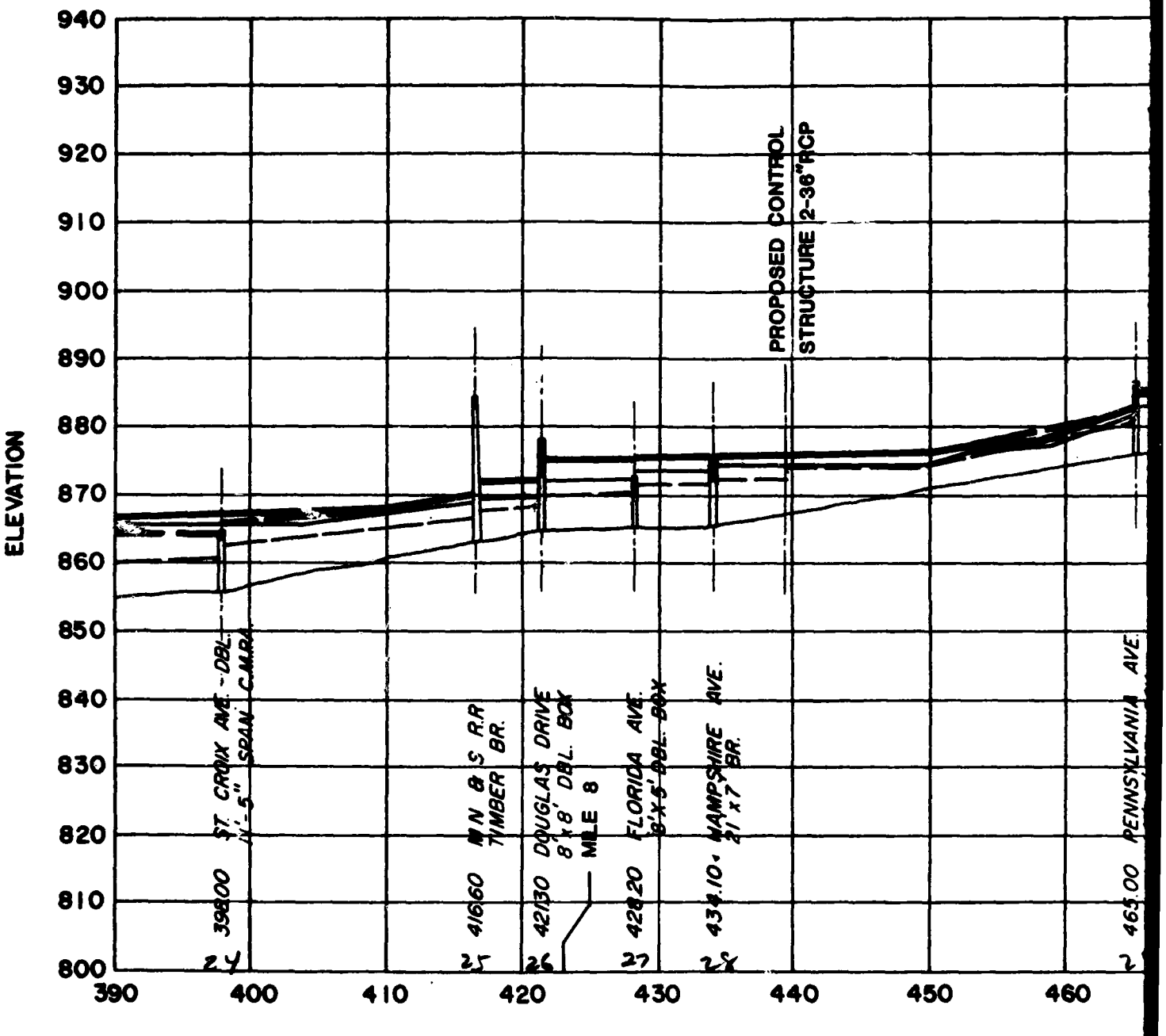
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

EXISTING AND PROPOSED FLOOD PROFILES MAIN STEM

2

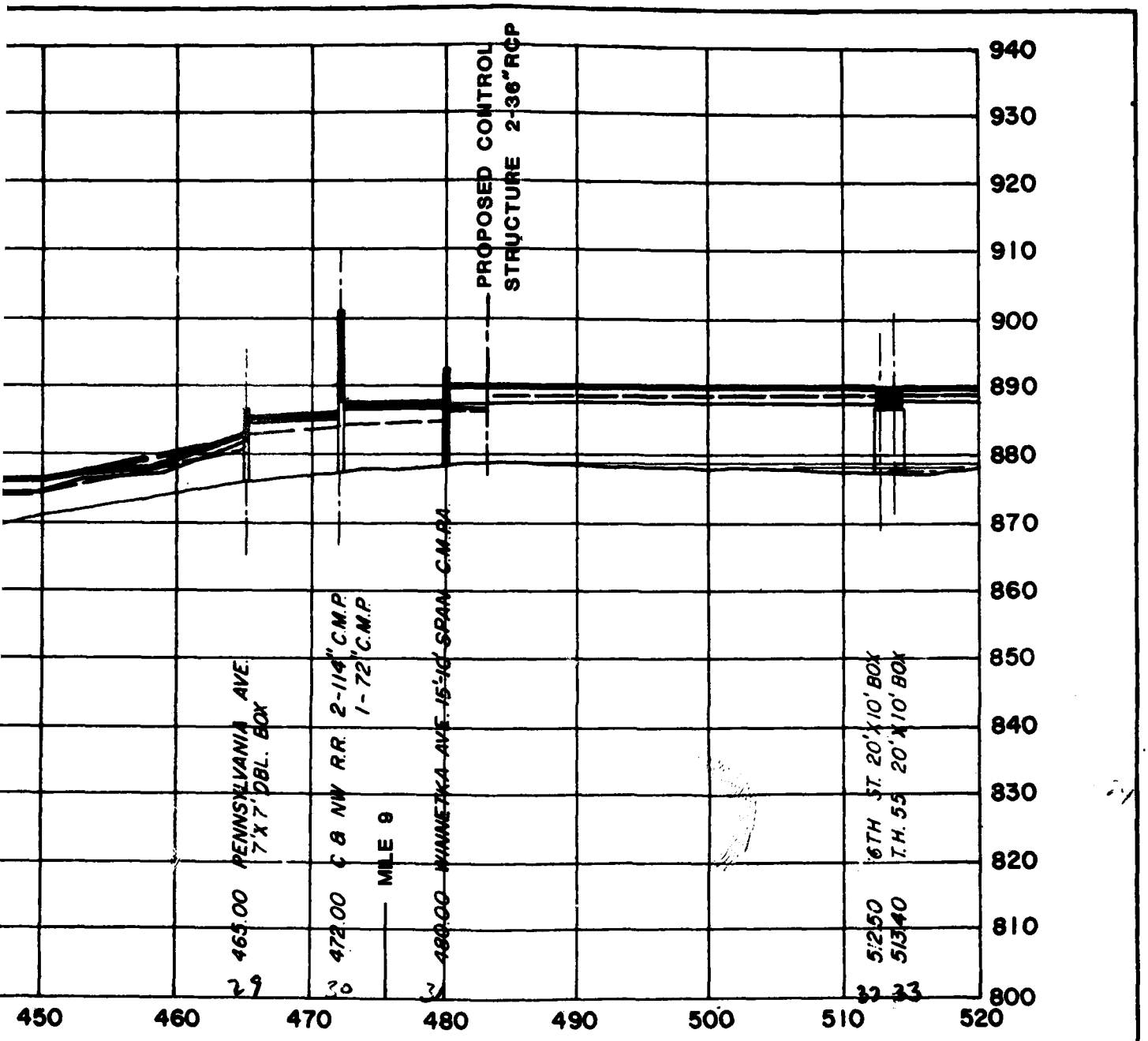
ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/33 MARCH 1976

PLATE H-16



LEGEND

	100-YEAR FLOOD	STANDARD PROJECT FLOOD
EXISTING	———	———
PROPOSED	—·—·—	— — —



TH MISSISSIPPI RIVER IN HUNDREDS OF FEET

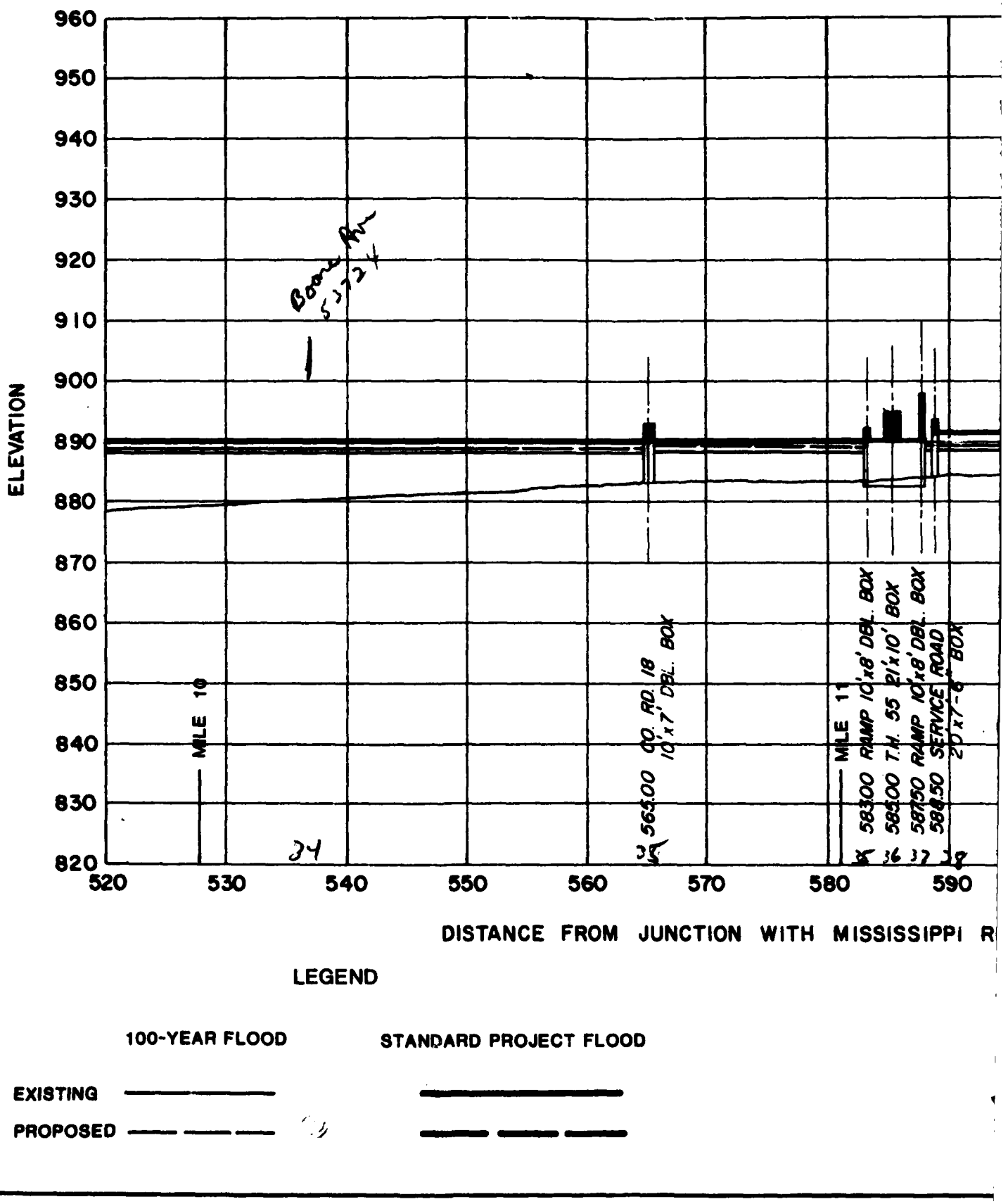
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

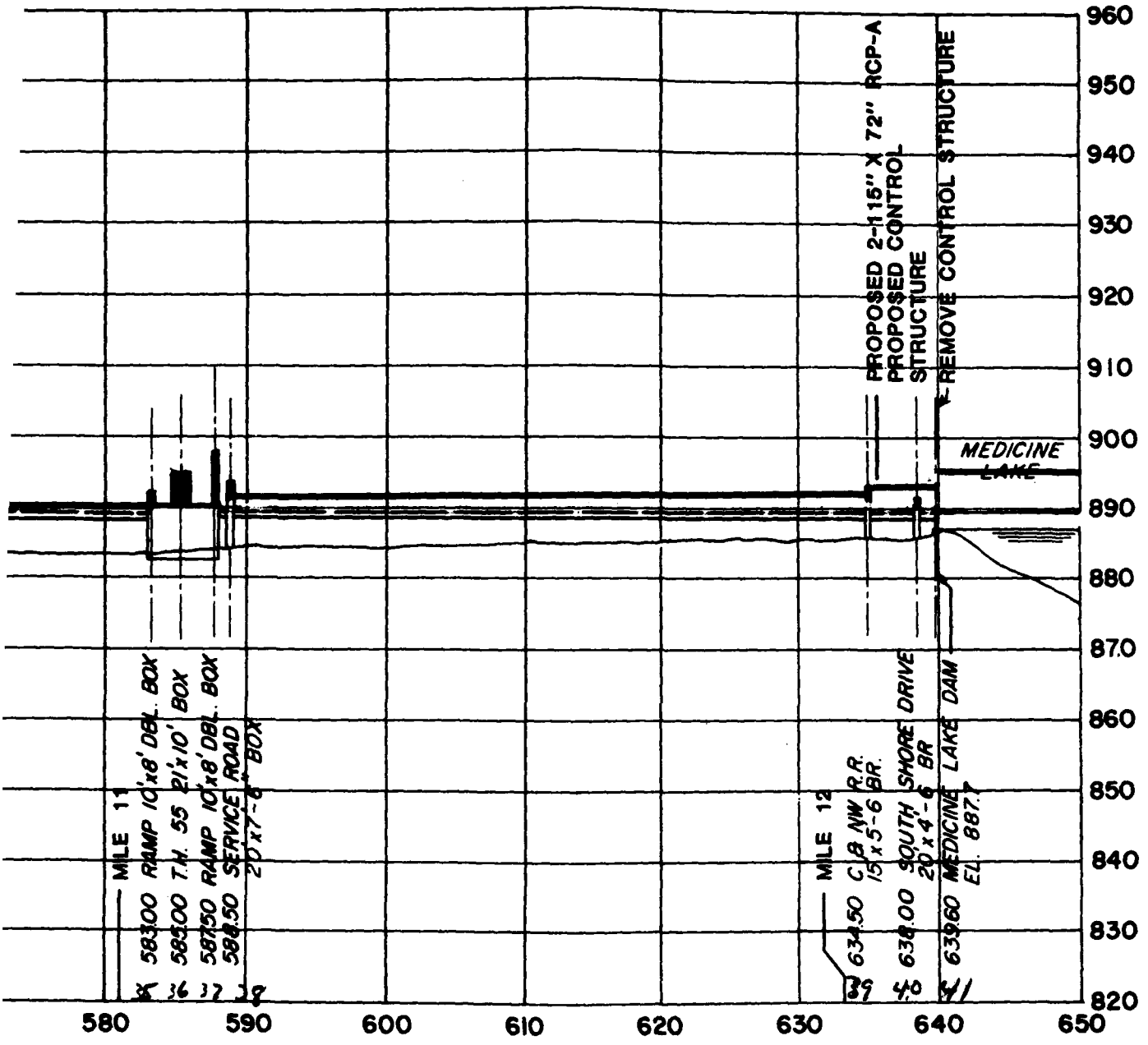
EXISTING AND PROPOSED FLOOD PROFILES MAIN STEM

2

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/34 MARCH 1976

PLATE H-17


960
950
940
930
920
910
900
890
880
870
860
850
840
830
820
ELEVATION
520
530
540
550
560
570
580
590
DISTANCE FROM JUNCTION WITH MISSISSIPPI R
MILE 10
MILE 11
56500 CO. RD. 18
10'x7' DBL. BOX
58300 RAMP 10'x8' DBL. BOX
58500 T.H. 55 2i'x10' BOX
58750 RAMP 10'x8' DBL. BOX
58850 SERVICE ROAD
20'x7'-6" BOX
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



WITH MISSISSIPPI RIVER IN HUNDREDS OF FEET

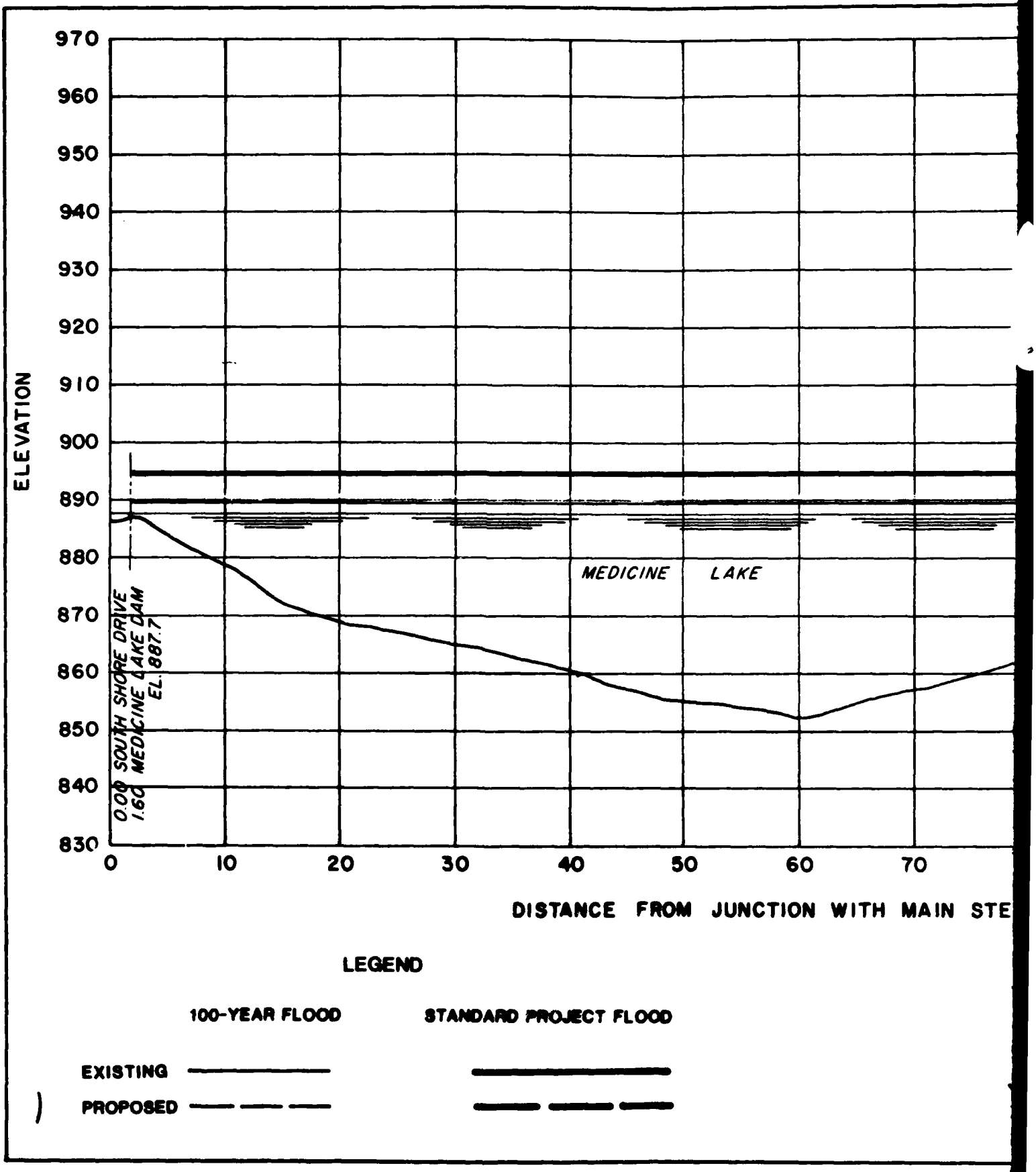
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

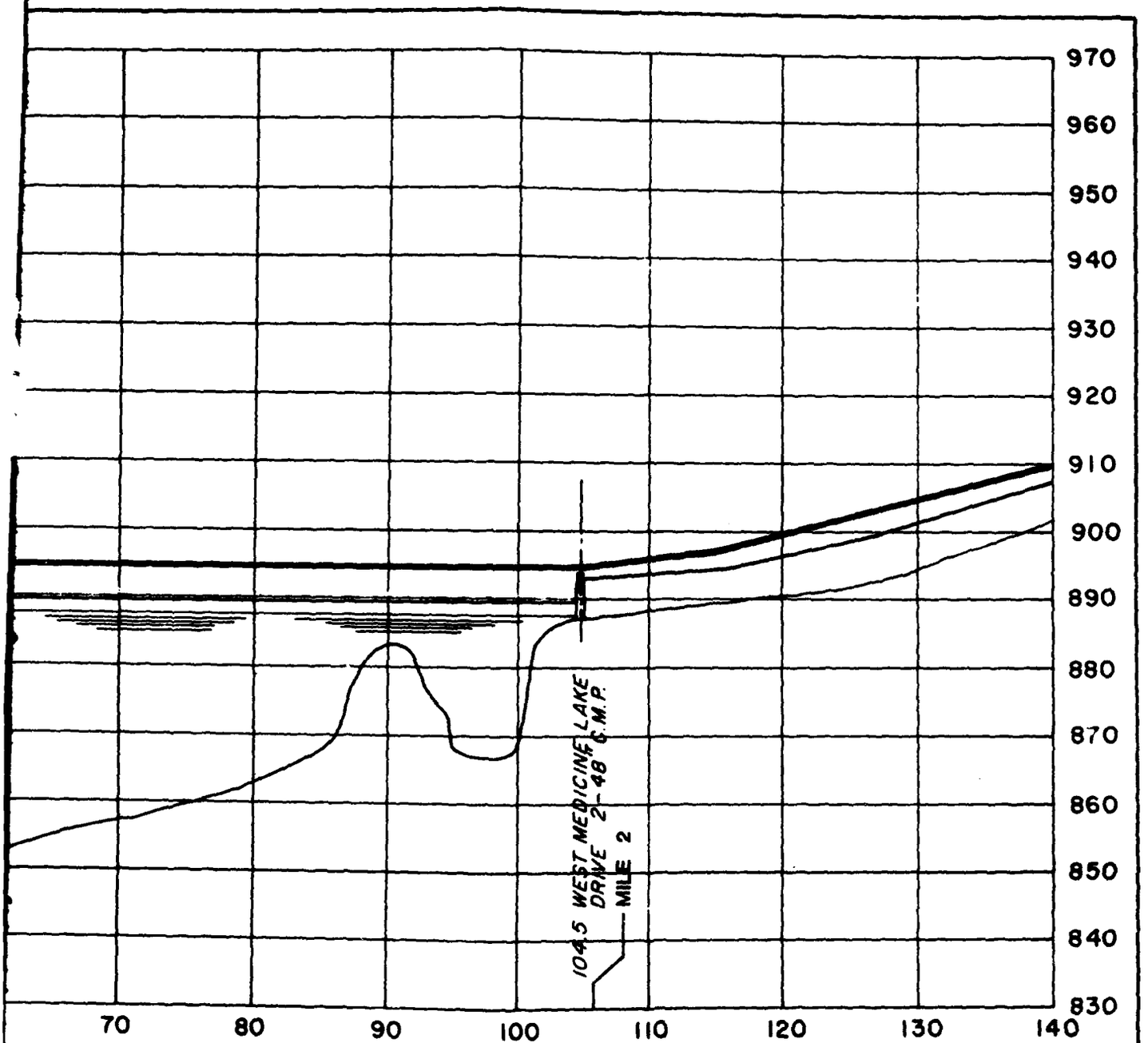
EXISTING AND PROPOSED FLOOD PROFILES MAIN STEM

ST. PAUL, MINN. DISTRICT
FILE NO. M 35.1-R-5/35 MARCH 1976

2

PLATE H-18


970
960
950
940
930
920
910
900
890
880
870
860
850
840
830
ELEVATION
0.00 SOUTH SHORE DRIVE
1.60 MEDICINE LAKE DAM
EL. 887.7
MEDICINE LAKE
0
10
20
30
40
50
60
70
DISTANCE FROM JUNCTION WITH MAIN STE
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



WITH MAIN STEM IN HUNDREDS OF FEET

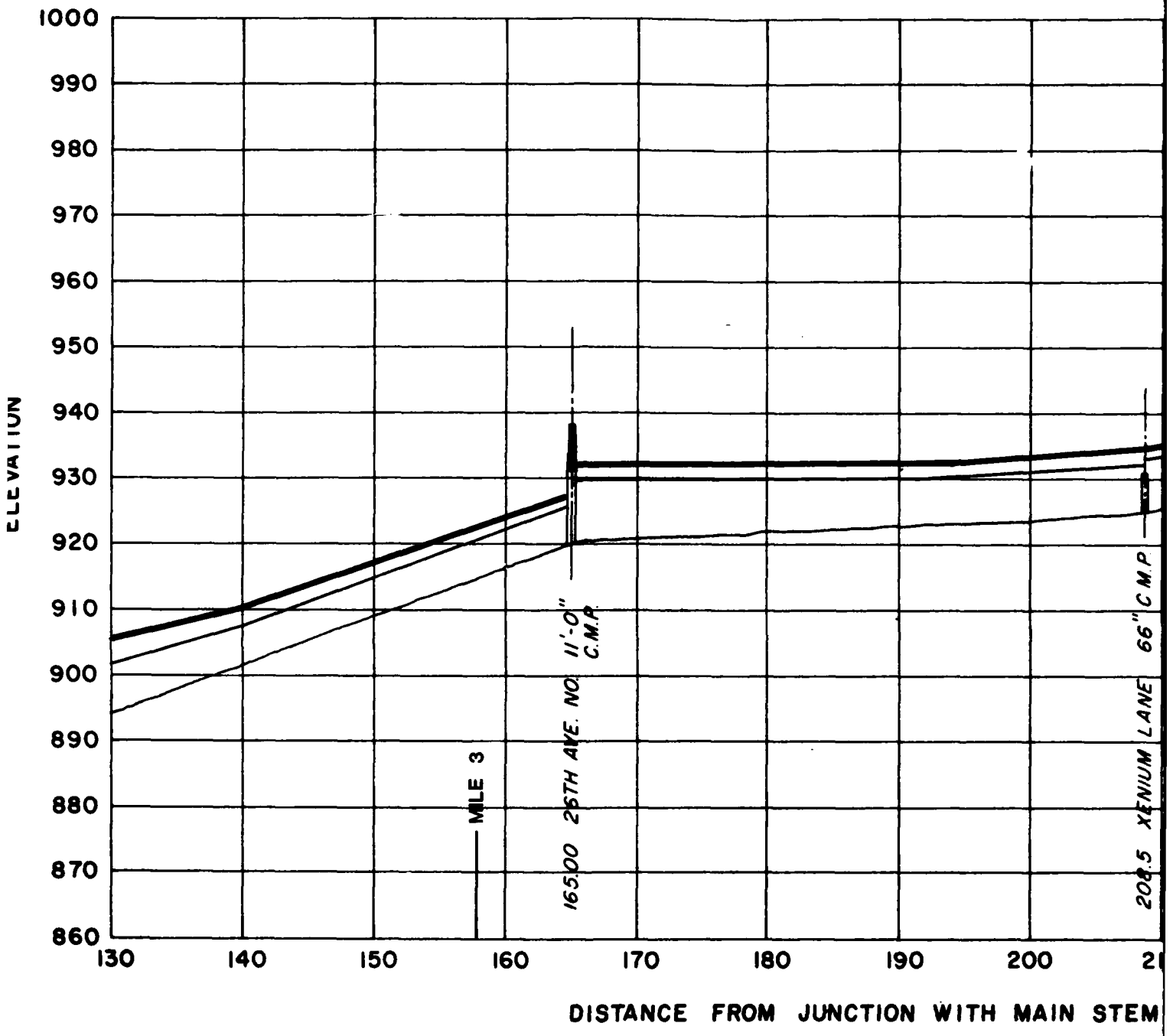
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

EXISTING AND PROPOSED FLOOD PROFILES MEDICINE LAKE BRANCH

2

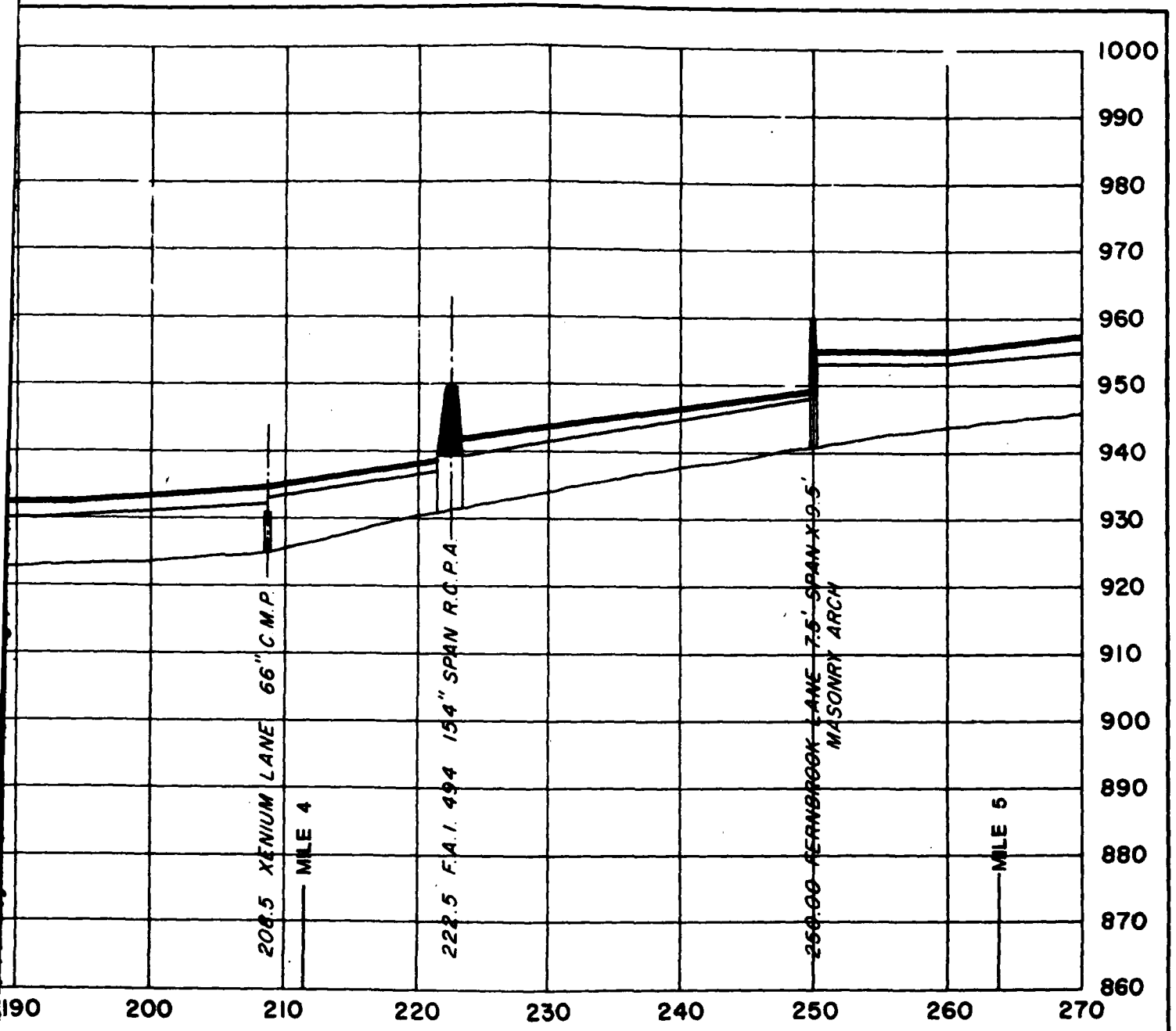
ST. PAUL, MINN. DISTRICT
FILE NO. M 35.1-R-5/36 MARCH 1976

PLATE H-19



LEGEND

	100-YEAR FLOOD	STANDARD PROJECT FLOOD
EXISTING	———	———
PROPOSED	— — —	— — —



ON WITH MAIN STEM IN HUNDREDS OF FEET

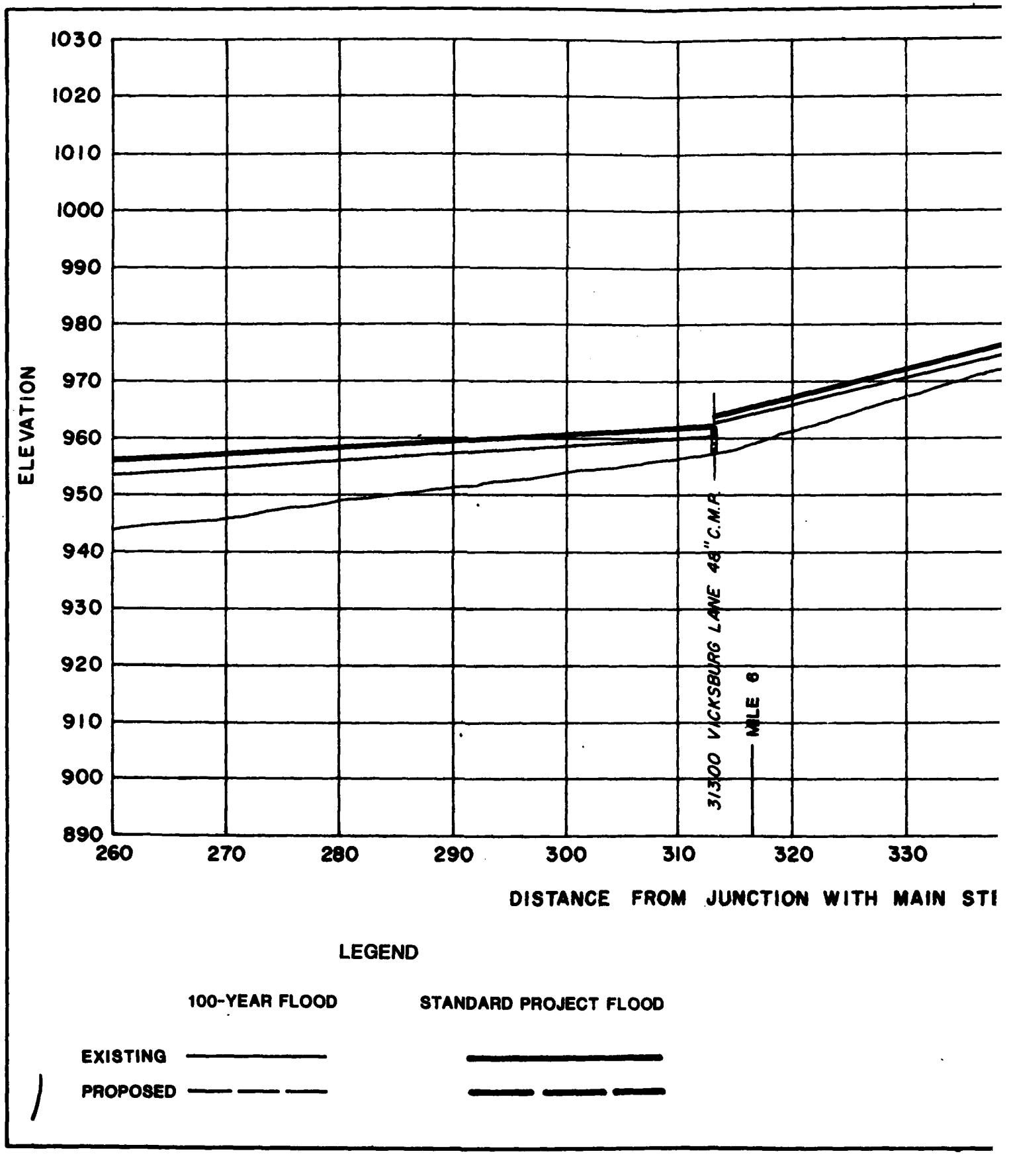
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

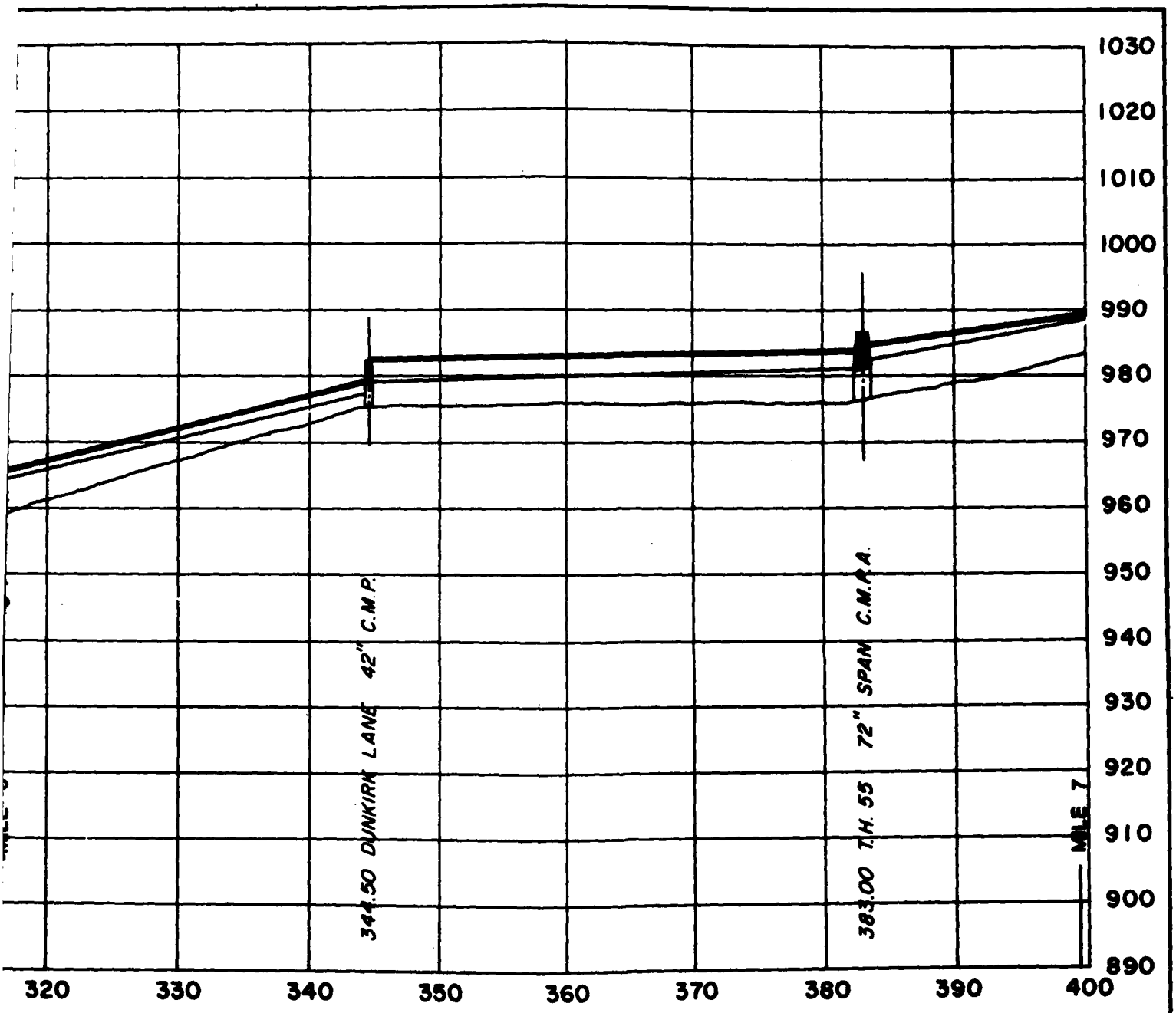
EXISTING AND PROPOSED FLOOD PROFILES MEDICINE LAKE BRANCH

2

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/37 MARCH 1976

PLATE H-20


1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
ELEVATION
260
270
280
290
300
310
320
330
DISTANCE FROM JUNCTION WITH MAIN STI
31300 VICKSBURG LANE 48" C.M.P.
MILE 6
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



CTION WITH MAIN STEM IN HUNDREDS OF FEET

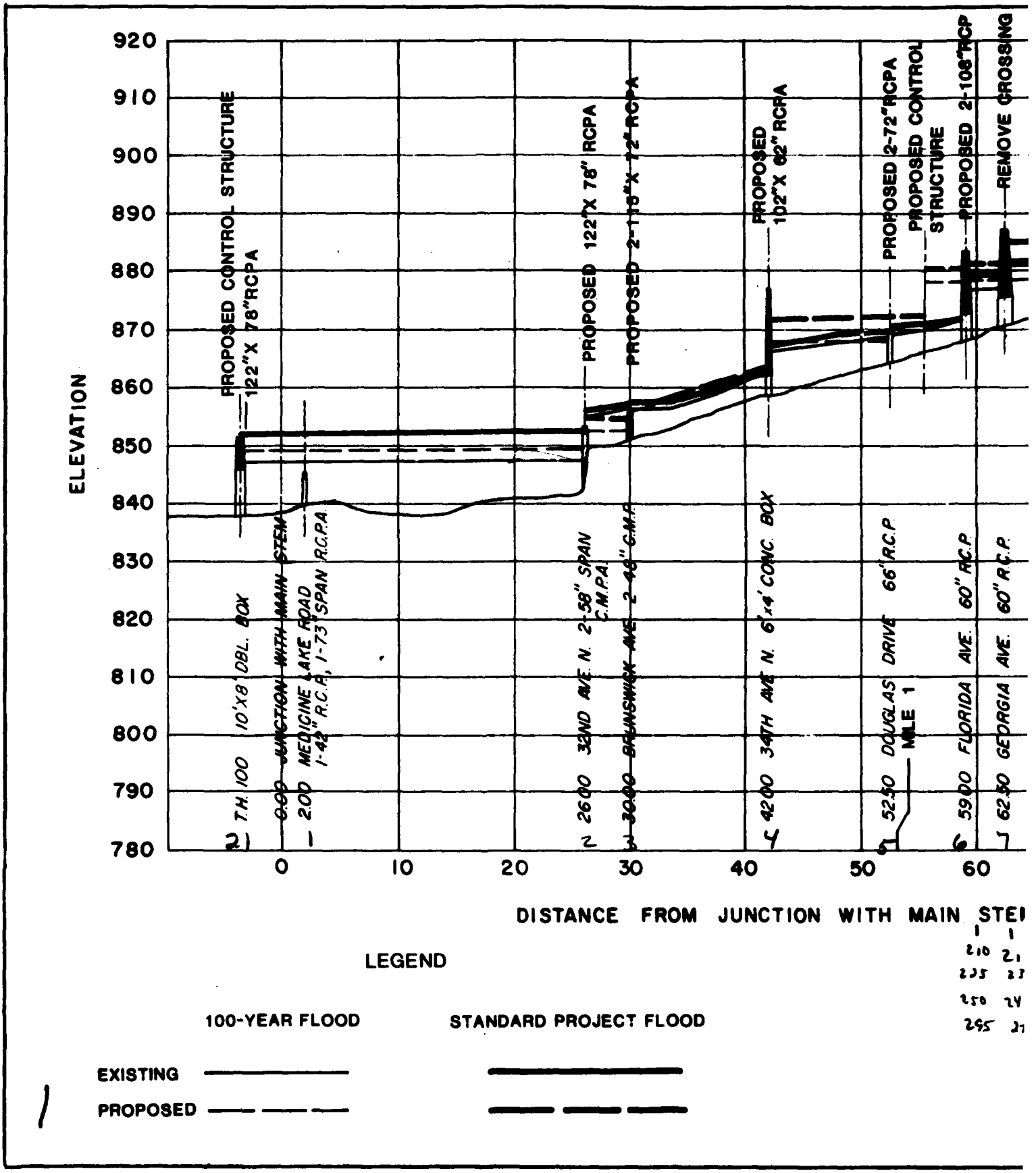
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

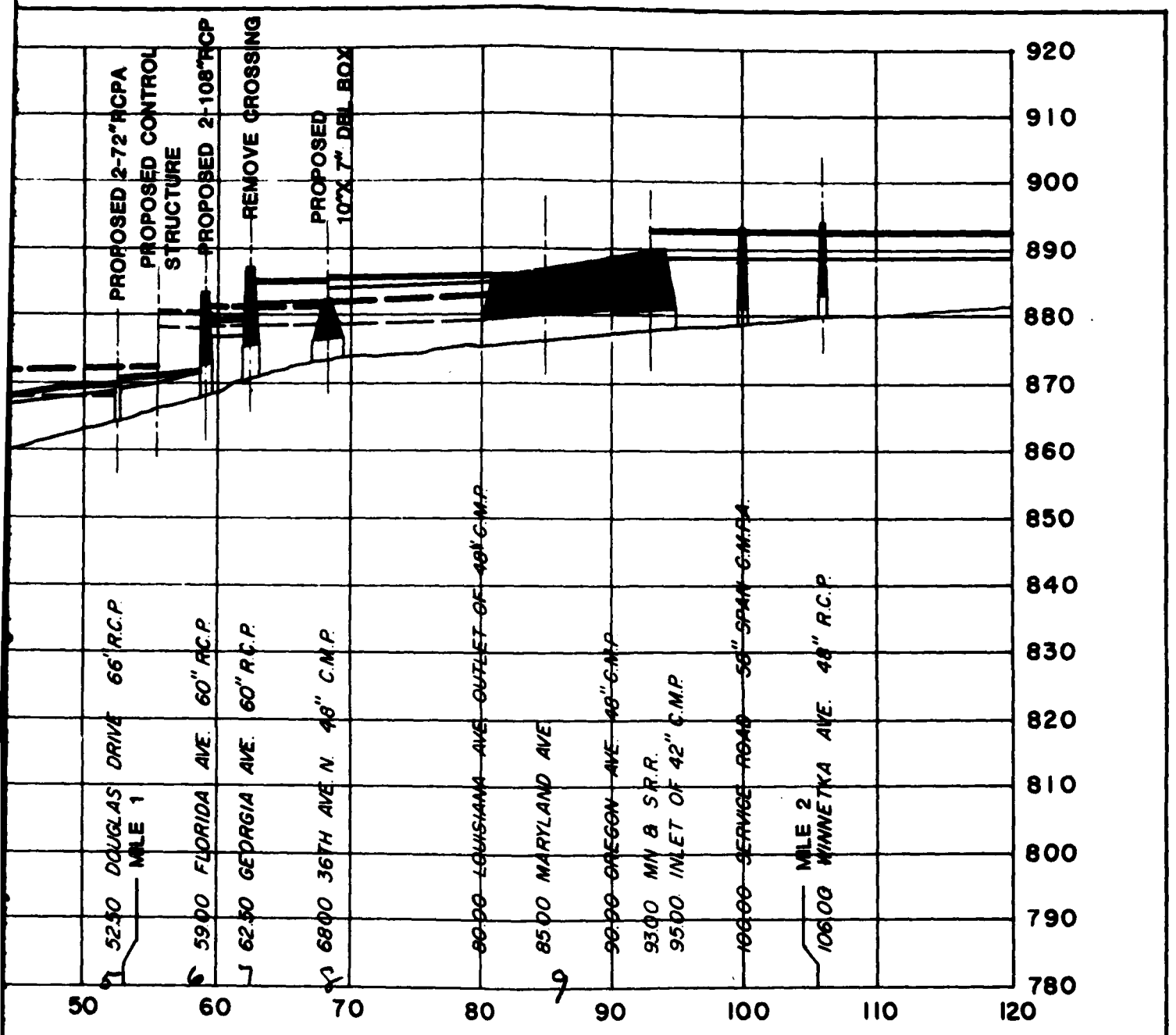
EXISTING AND PROPOSED FLOOD PROFILES MEDICINE LAKE BRANCH

2

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/38 MARCH 1976

PLATE H-21


ELEVATION
920
910
900
890
880
870
860
850
840
830
820
810
800
790
780
0
10
20
30
40
50
60
DISTANCE FROM JUNCTION WITH MAIN STEM
PROPOSED CONTROL STRUCTURE 122"X 78"RCPA
PROPOSED 122"X 78" RCPA
PROPOSED 2-115"X 72" RCPA
PROPOSED 102"X 62" RCPA
PROPOSED 2-72"RCPA
PROPOSED CONTROL STRUCTURE
PROPOSED 2-108"RCP
REMOVE CROSSING
T.H. 100
10'X8' DBL. BOX
0.00 JUNCTION WITH MAIN STEM
2.00 MEDICINE LAKE ROAD
1-42" R.C.A, 1-73" SPAN R.C.P.A.
N 26.00 32ND AVE N. 2-58" SPAN C.M.P.A.
W 30.00 BRUNSWICK AVE 2-48" C.M.P.
E 42.00 34TH AVE N. 6'x4' CONC. BOX
52.50 DOUGLAS DRIVE 66" R.C.P
MILE 1
59.00 FLORIDA AVE. 60" R.C.P
62.50 GEORGIA AVE. 60" R.C.P
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



ON WITH MAIN STEM IN HUNDREDS OF FEET

210	210	245	50
235	235	255	100 Ex.s-
250	245	200	100 ULT.
295	270		SPF

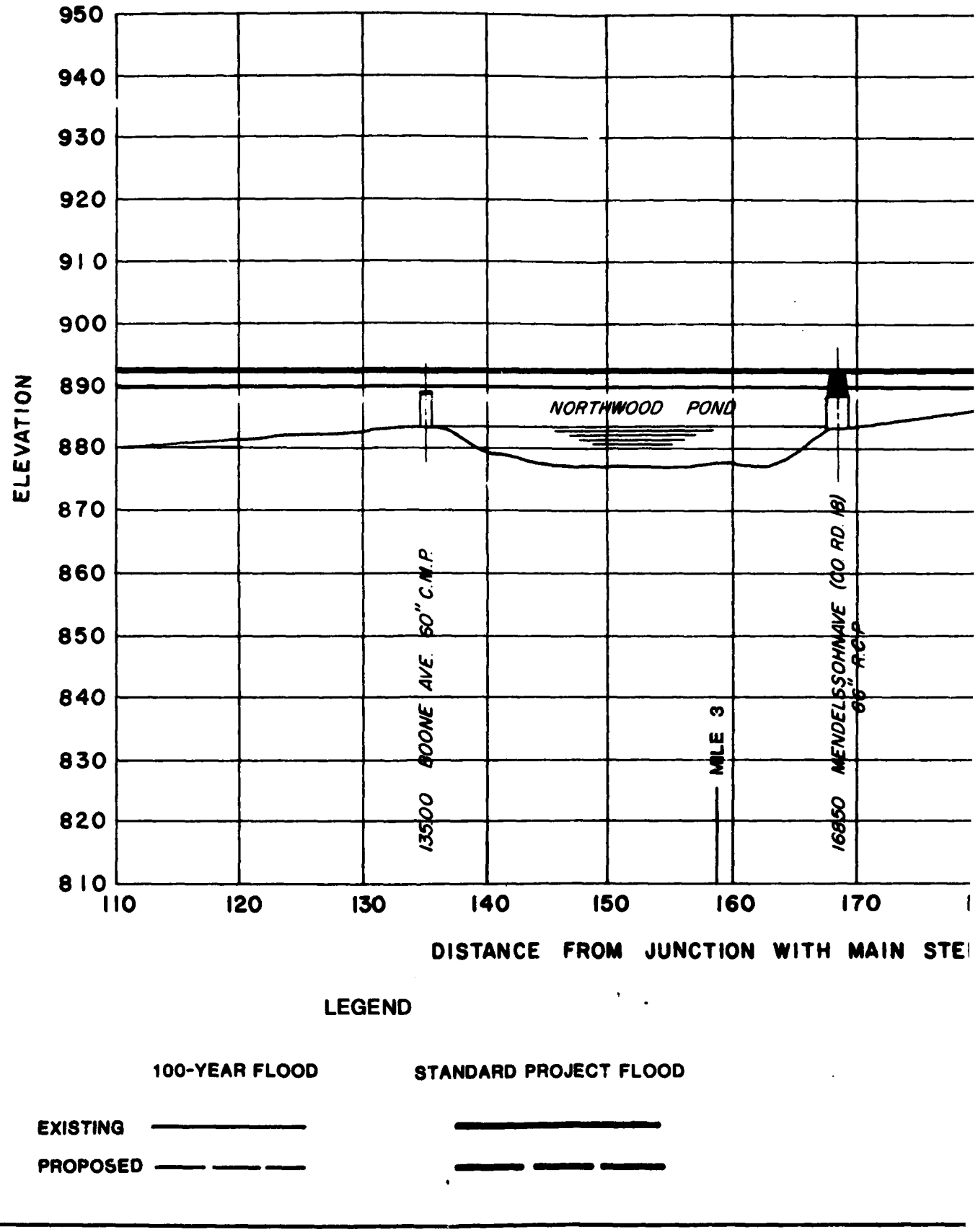
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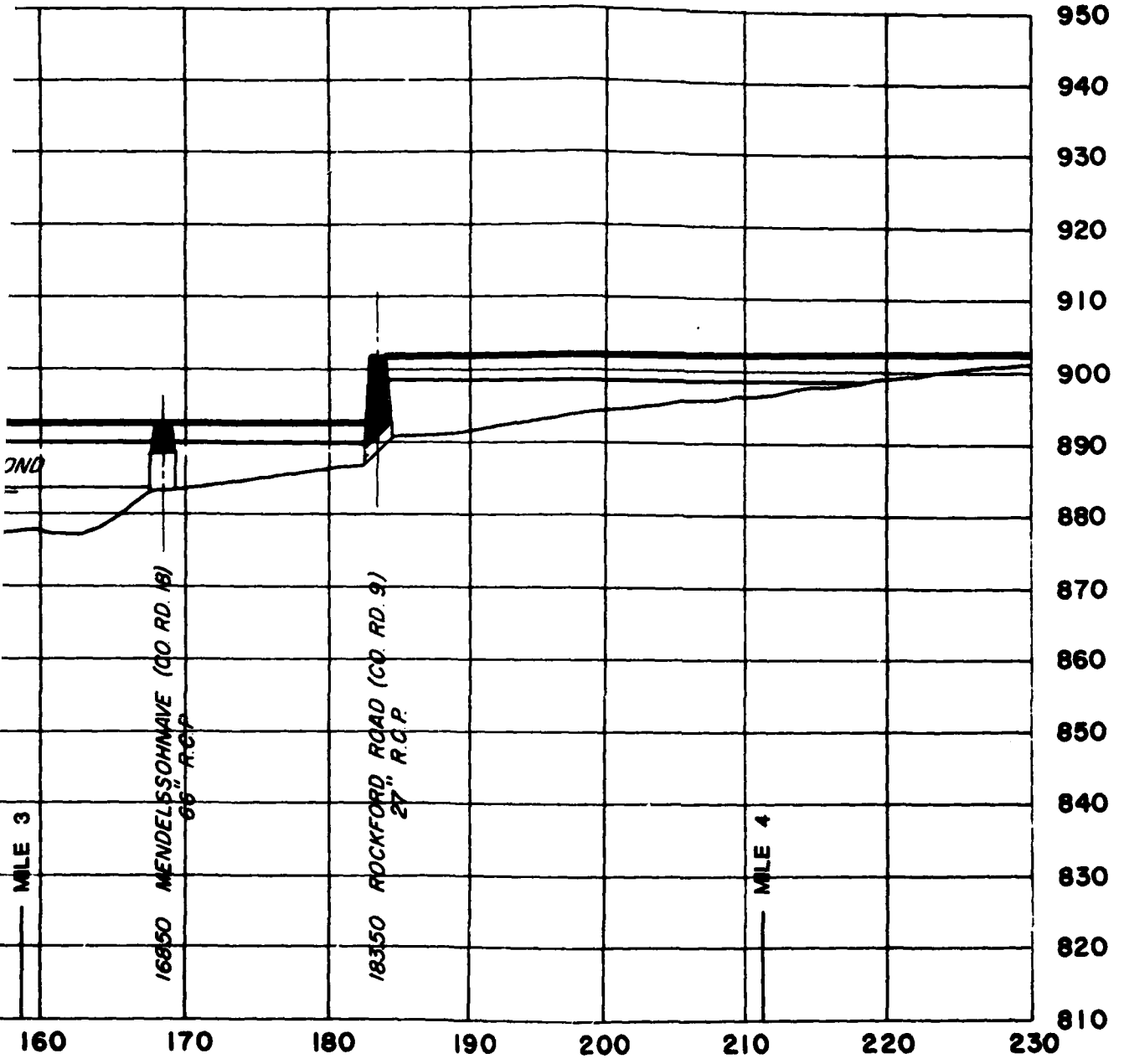
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

EXISTING AND PROPOSED FLOOD PROFILES NORTH BRANCH

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/39 MARCH 1976

PLATE H-22


950
940
930
920
910
900
890
880
870
860
850
840
830
820
810
ELEVATION
110
120
130
140
150
160
170
NORTHWOOD POND
13500 BOONE AVE. 60" C.M.P.
MILE 3
16850 MENDELSSOHN AVE (CO RD. 18) 66" R.C.P.
DISTANCE FROM JUNCTION WITH MAIN STE
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



CTION WITH MAIN STEM IN HUNDREDS OF FEET

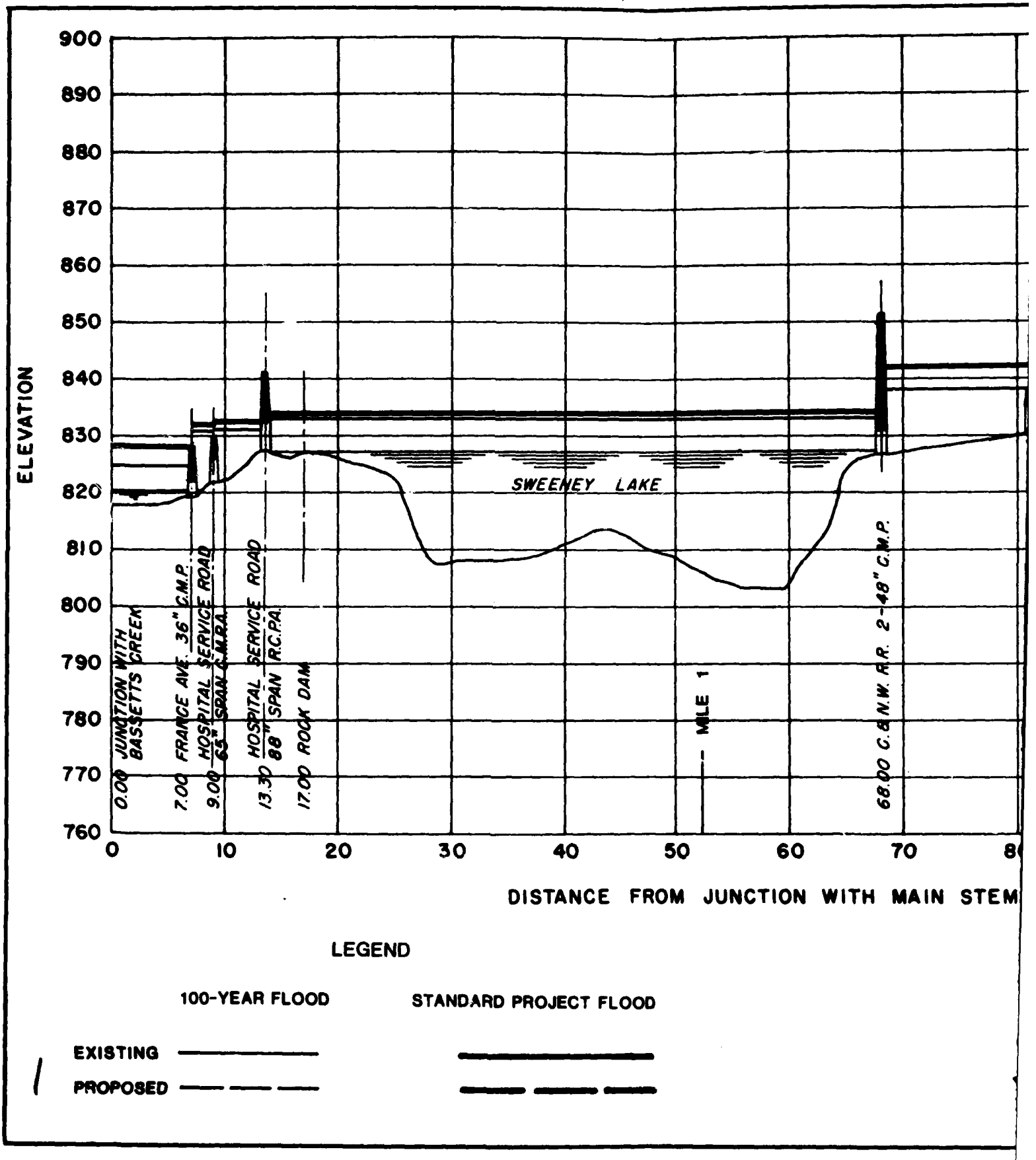
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

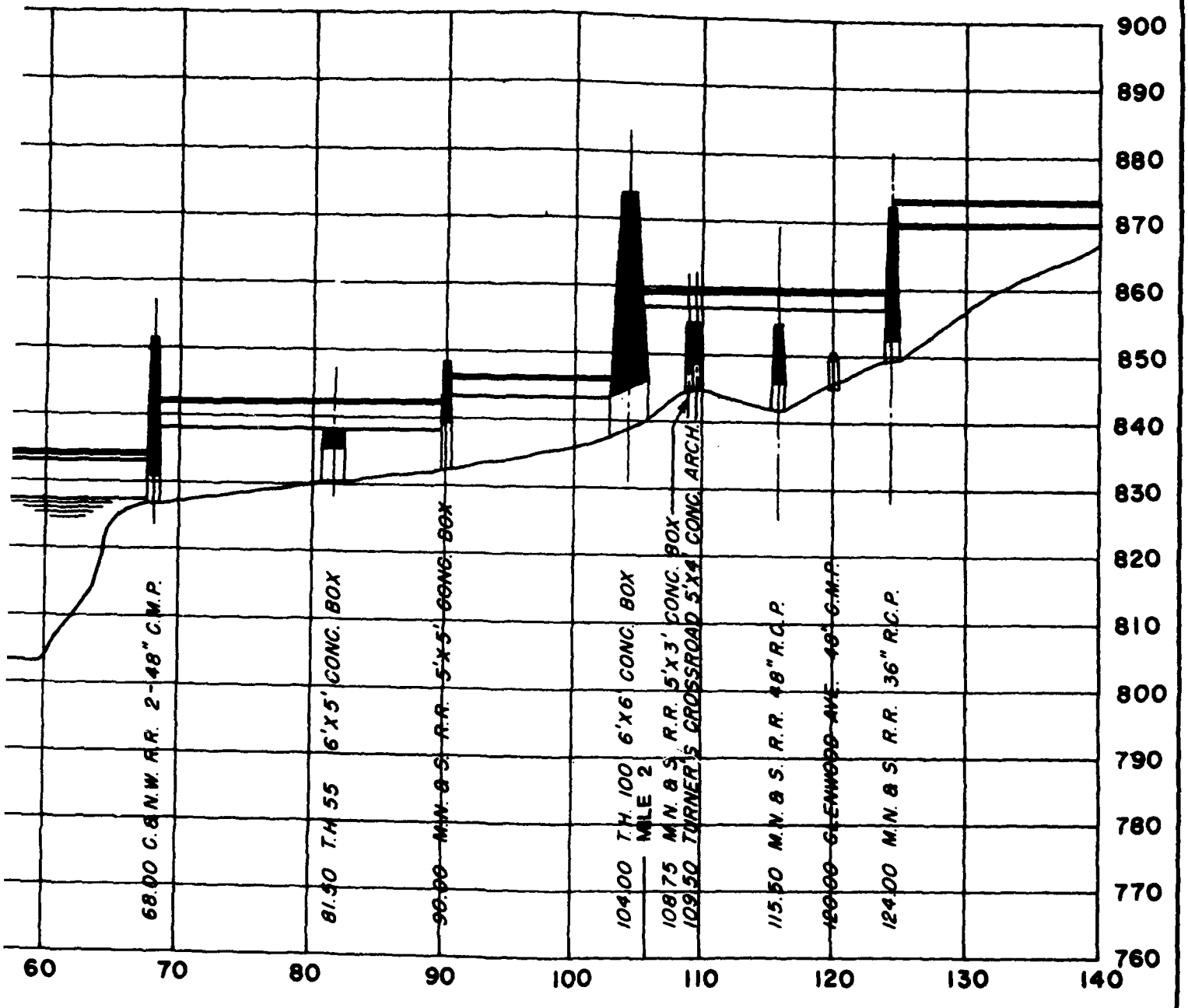
EXISTING AND PROPOSED FLOOD PROFILES NORTH BRANCH

2

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/40 MARCH 1976

PLATE H-23


ELEVATION
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
0
10
20
30
40
50
60
70
80
DISTANCE FROM JUNCTION WITH MAIN STEM
SWEENEY LAKE
0.00 JUNCTION WITH BASSETTS CREEK
7.00 FRANCE AVE. 36" C.M.P.
9.00 HOSPITAL SERVICE ROAD 65' SPAN C.M.P.A.
13.30 HOSPITAL SERVICE ROAD 88' SPAN R.C.P.A.
17.00 ROCK DAM
MILE 1
68.00 C.&N.W. R.R. 2-48" C.M.P.
LEGEND
100-YEAR FLOOD
STANDARD PROJECT FLOOD
EXISTING
PROPOSED



TION WITH MAIN STEM IN HUNDREDS OF FEET

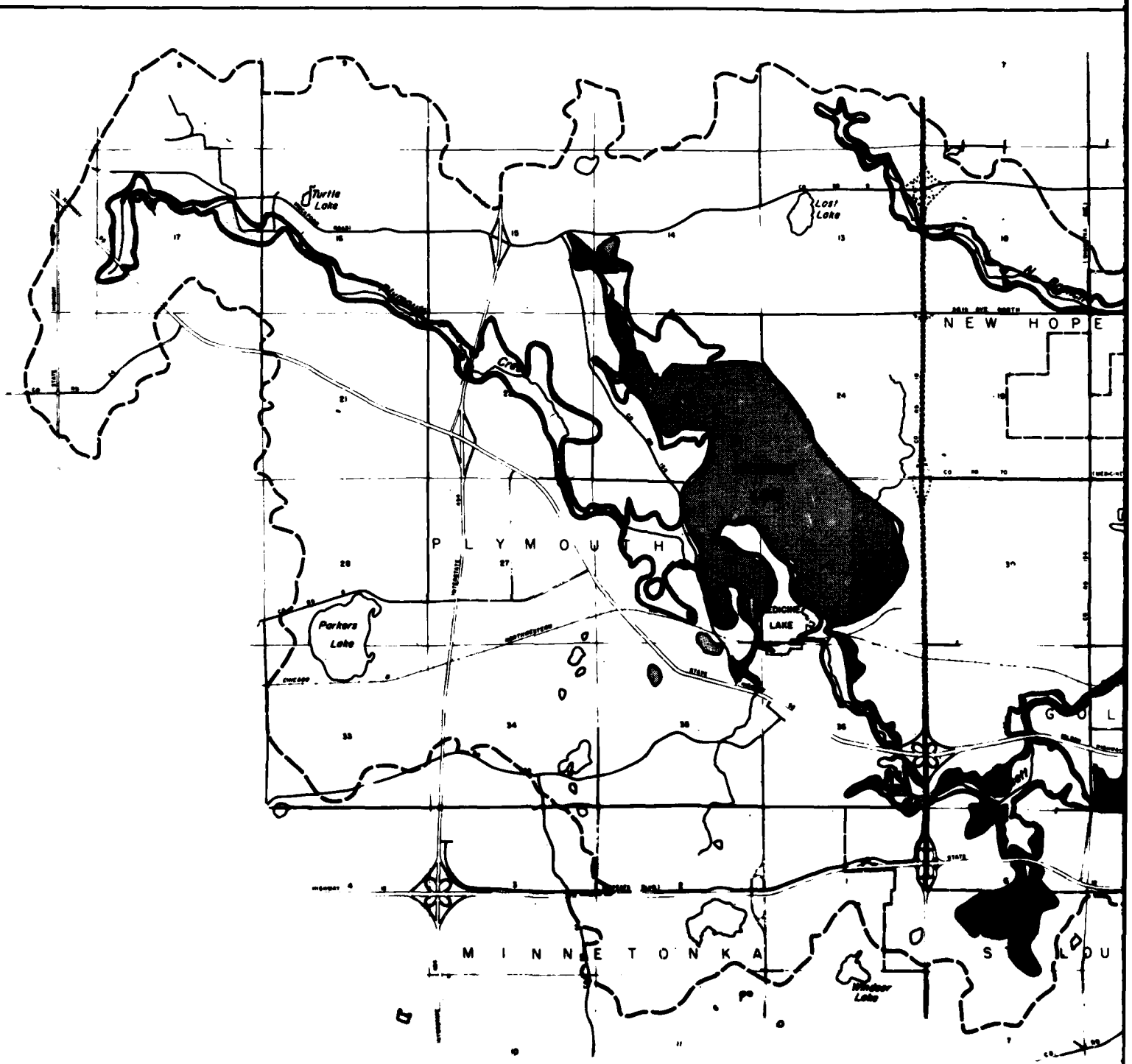
FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

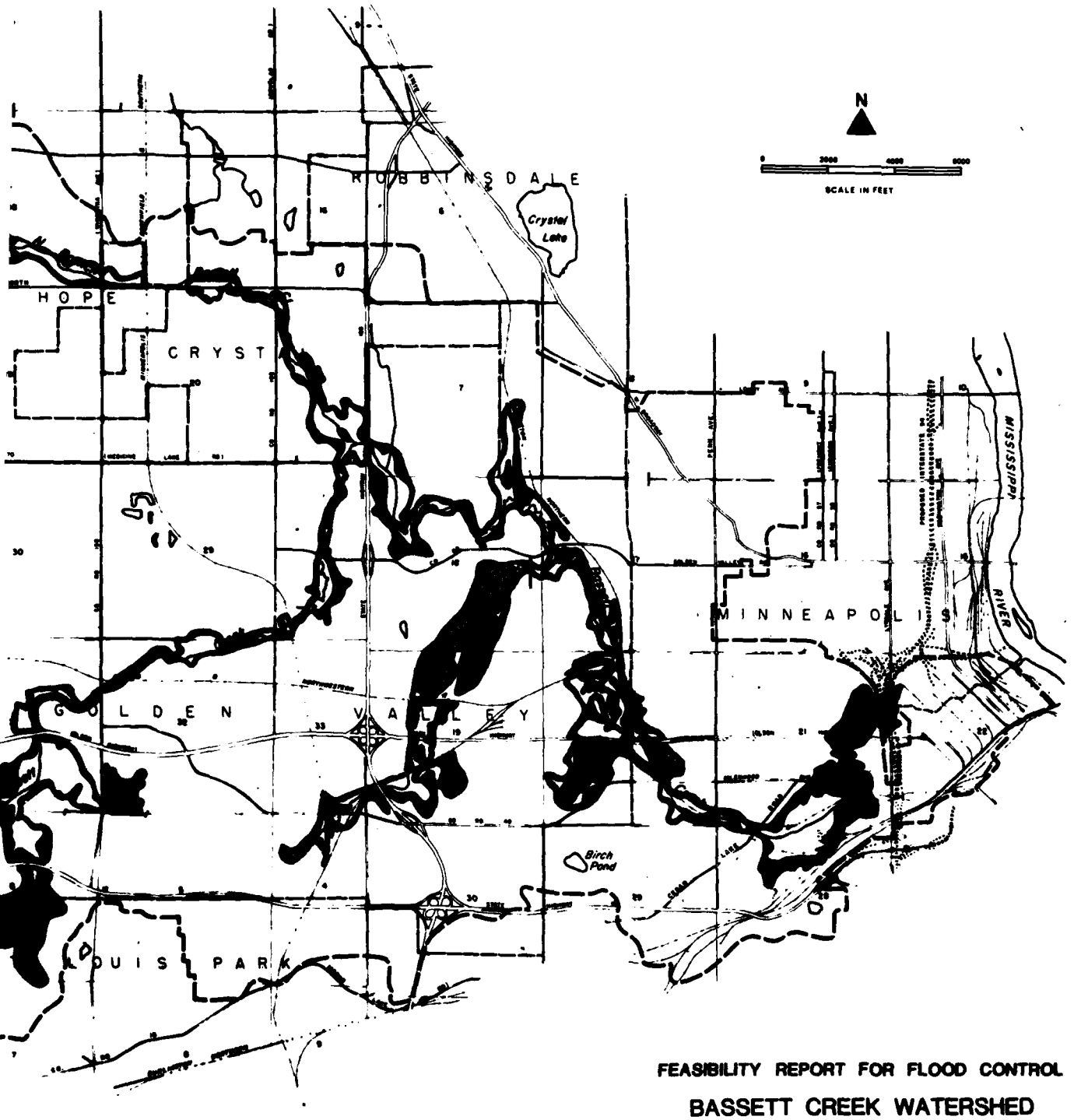
EXISTING AND PROPOSED FLOOD PROFILES SWEENEY LAKE BRANCH

2

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/41 MARCH 1976

PLATE H-24


Turtle Lake
Lost Lake
NEW HOPE
PLYMOUTH
Parkers Lake
MEDICINE LAKE
MINNETONKA
Wirth Lake
LEGEND
100 YEAR FLOOD
STANDARD PROJECT FLOOD



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

FLOOD OUTLINE MAP

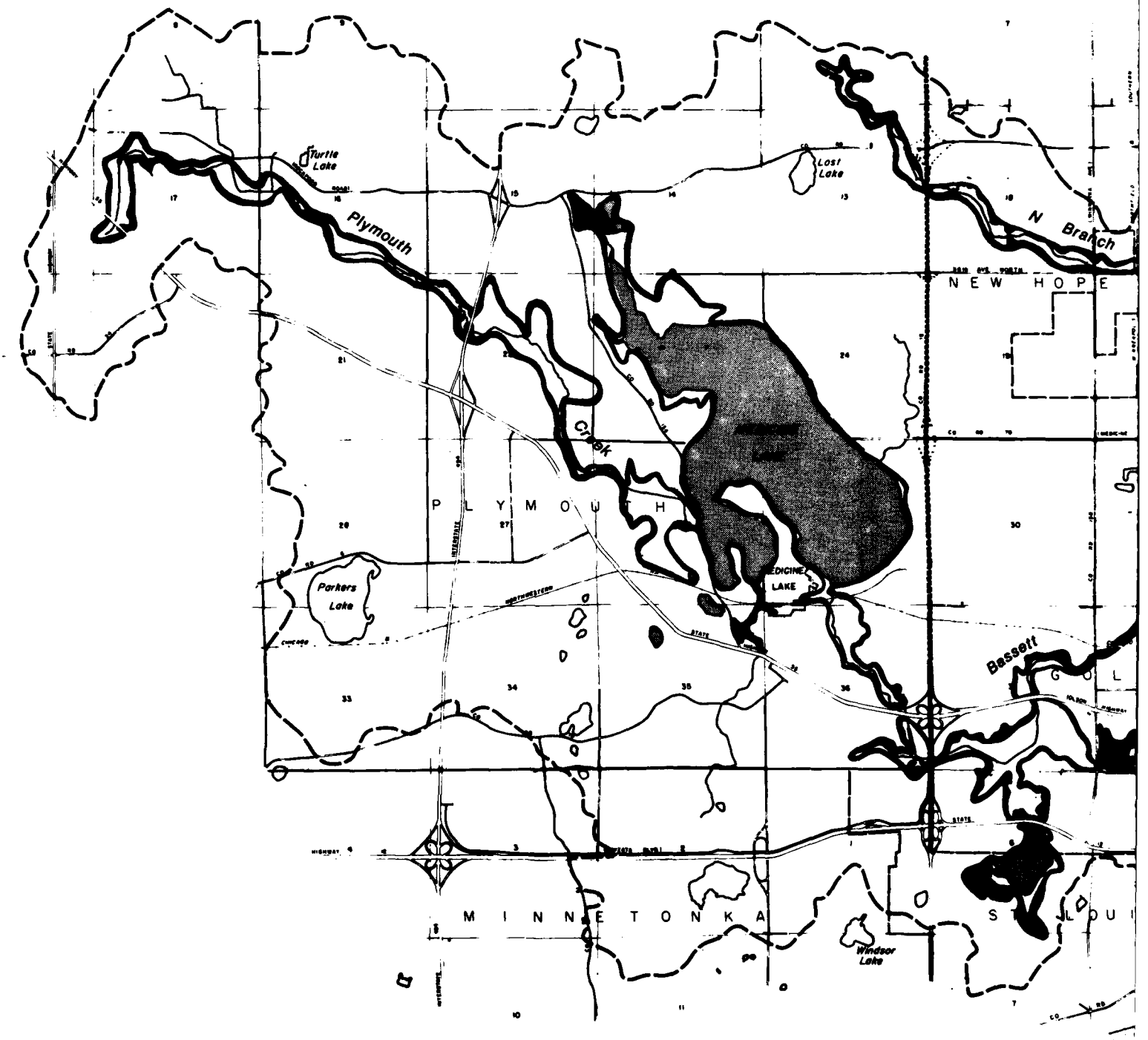
EXISTING CONDITIONS

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-5/42 MARCH 1976

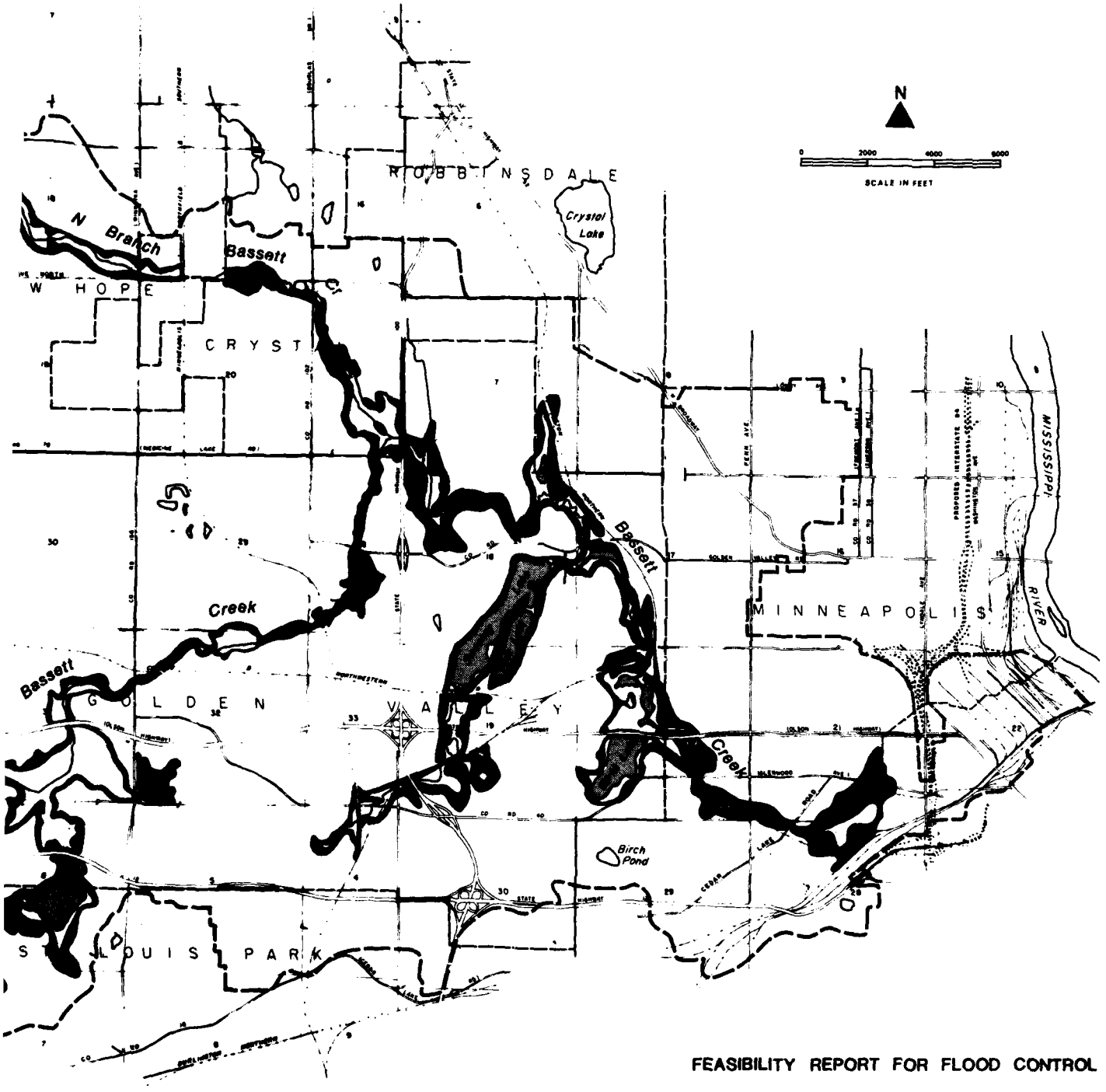
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PLATE H-25



LEGEND

100 YEAR FLOOD — STANDARD PROJECT FLOOD



FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

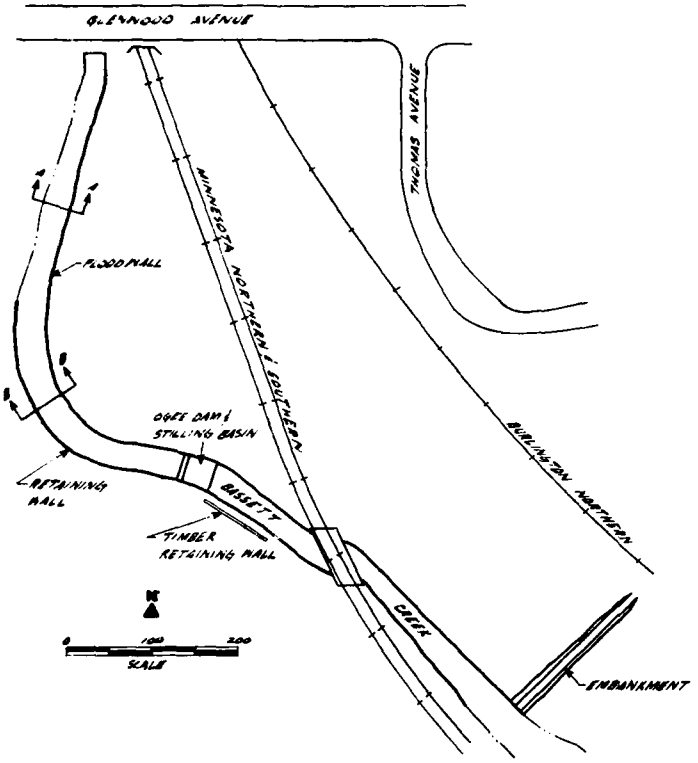
FLOOD OUTLINE MAP
PROPOSED CONDITIONS

ST. PAUL MINN. DISTRICT

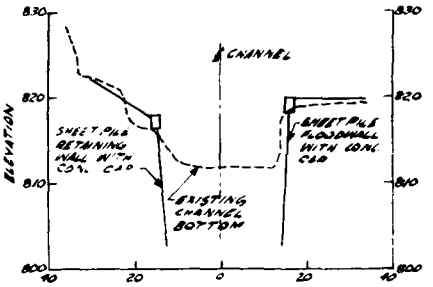
FILE NO. M35.1-R-5/43 MARCH 1976

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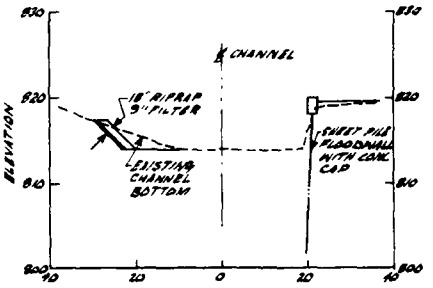
PLATE H-26



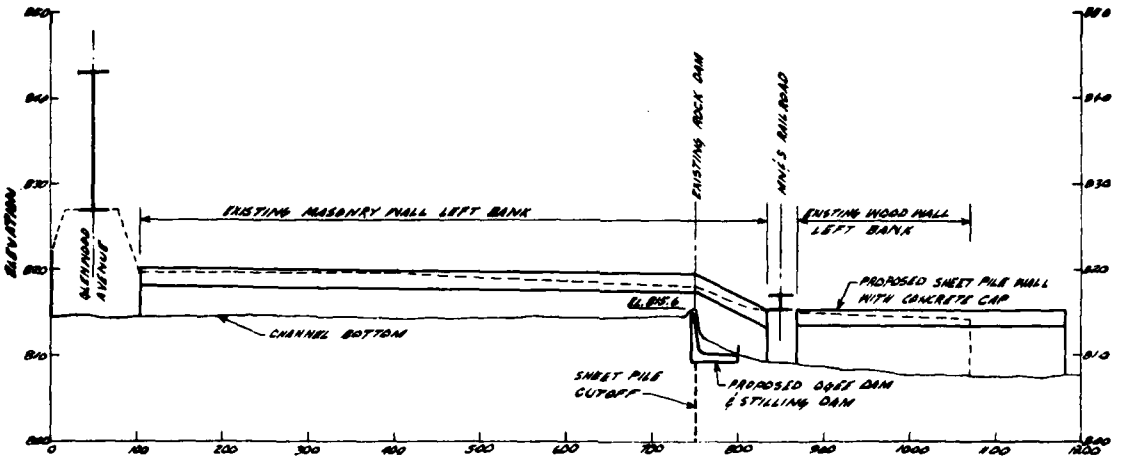
LOCATION



TYPICAL SECTION B-B



TYPICAL SECTION A-A



FLOODWALL-PROFILE

FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

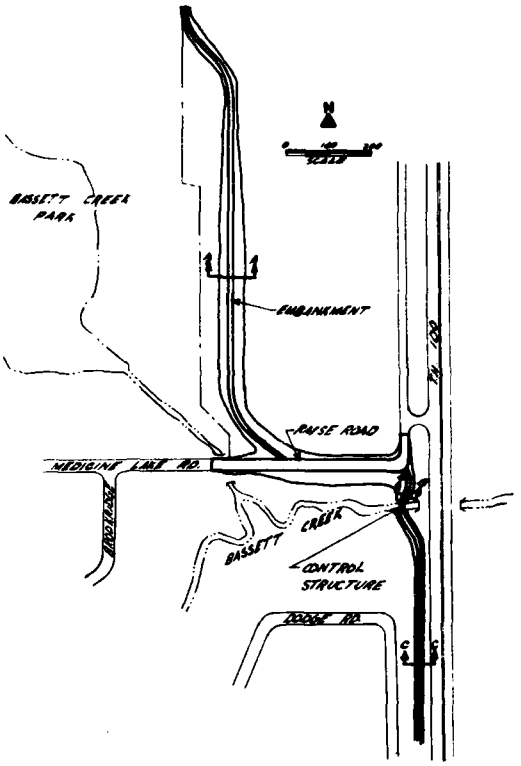
FLOODWALLS AND RETAINING WALLS GLENWOOD AVENUE

PLAN, PROFILE & SECTIONS

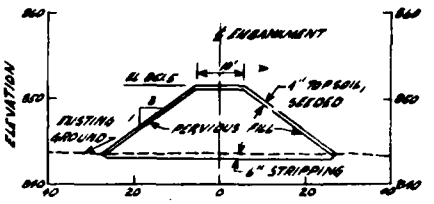
ST. PAUL MINN. DISTRICT

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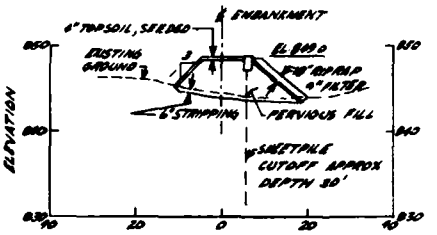
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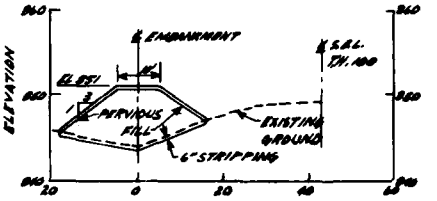
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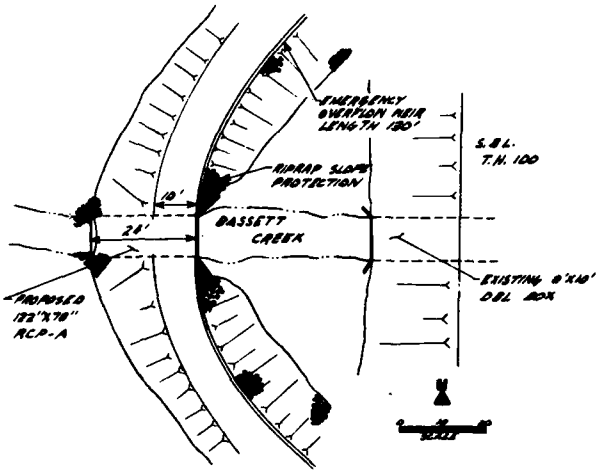
TYPICAL SECTION A-A



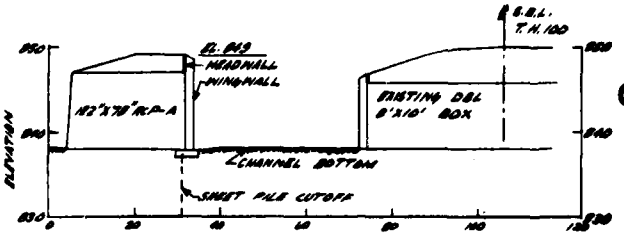
TYPICAL SECTION B-B



TYPICAL SECTION C-C



PLAN



PROFILE-CONTROL STRUCTURE

FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

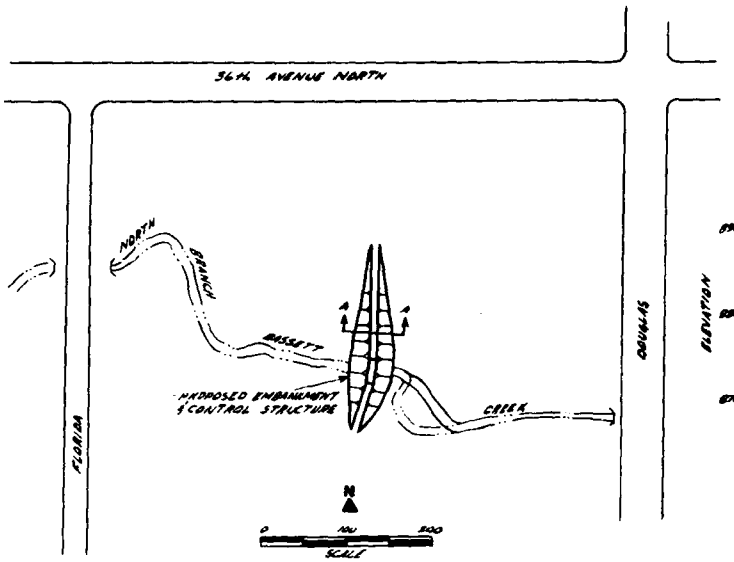
CONTROL STRUCTURE BASSETT CREEK PARK

PLAN, PROFILE & SECTIONS

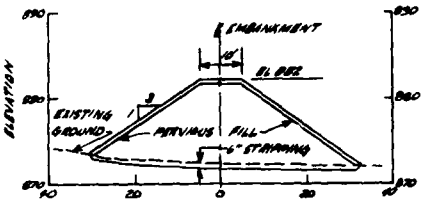
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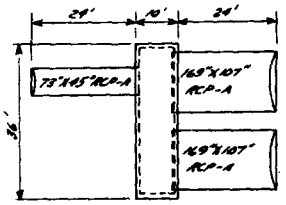
PLATE H-26



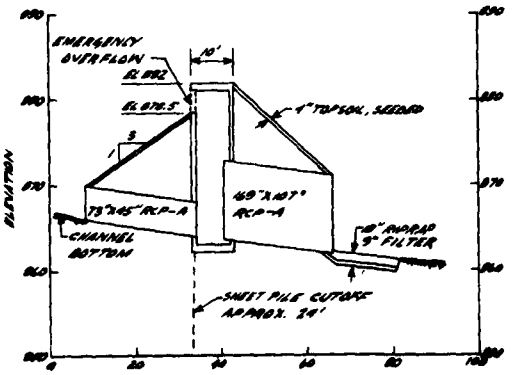
LOCATION



TYPICAL SECTION A-A



PLAN-CONTROL STRUCTURE



SECTION-CONTROL STRUCTURE

FEASIBILITY REPORT FOR FLOOD CONTROL

BASSETT CREEK WATERSHED

CONTROL STRUCTURE

DOUGLAS - FLORIDA AVE.

PLAN, PROFILE & SECTIONS

ST. PAUL MINN. DISTRICT

FILE NO. M35.1-R-6/46 MARCH 1978

PLATE H-26

SECTION I

FLOOD PLAIN REGULATIONS

FLOOD PLAIN REGULATIONS

Table of Contents

Item	Page
PURPOSE AND SCOPE	I-1
AVAILABLE DATA	I-1
METHODS OF FLOOD DAMAGE REDUCTION	I-2
CONTROL OVER THE LAND	I-2
Designated Floodways	I-4
Zoning	I-4
Subdivision Regulations	I-5
Building Codes	I-6
Development Policies	I-7
Bassett Creek Flood Plain Zoning	I-7
FLOOD PROOFING	I-12
FLOOD WARNING-FORECASTING	I-15
TEMPORARY EVACUATION	I-16
PERMANENT EVACUATION	I-16
OPEN SPACES	I-17
WARNING SIGNS	I-17
BUILDING FINANCING	I-17
FLOOD INSURANCE	I-18
BRIDGES	I-19
PERMANENT EVACUATION AS AN ALTERNATIVE TO PROPOSED STRUCTURAL IMPROVEMENTS	I-20
FLOOD PLAIN REGULATION AS AN ALTERNATIVE TO PROPOSED STRUCTURAL ALTERNATIVES	I-20
FLOOD PLAIN REGULATION AS A SUPPLEMENT TO PROPOSED STRUCTURAL IMPROVEMENTS	I-21

Plates

Plate No.	
I-1	FLOOD PLAIN SCHEMATIC
I-2	A FLOOD PROOFED STRUCTURE
I-3	METHODS FOR CONTROLLING SEWER BACKUP

SECTION I

FLOOD PLAIN REGULATION

PURPOSE AND SCOPE

This section presents flood plain management measures available for reducing flood losses and their relationship to existing and future loss potential. The combined solutions involving increased flood storage, channel modifications, improved channel crossing and conduit improvements, land-use controls, and other measures are required to insure proper management of the flood plain and to minimize future flood losses. This section describes flood plain management measures undertaken by the Bassett Creek Flood Control Commission and municipalities within the watershed, and other measures local governments can take to control future land use and development and thus reduce the flood threat to the residual flood plain not afforded flood protection.

AVAILABLE DATA

Information on the flood situation in the Bassett Creek watershed, including data on rainfall, runoff, and predicted flood levels, is contained in the "Watershed Management Plan for Bassett Creek", prepared by the Bassett Creek Flood Control Commission in February, 1972. The plan defines areas to be managed in order to preserve the various options available for flood control until a flood control plan which best meets the need of the public can be selected. The Phase I feasibility report provided additional information on historical and predicted flood levels, and indicated that nonstructural measures, in combination with various alternative structural measures, appear feasible and warrant additional study.

Information on streamflow records, past floods, and flood frequencies is provided in Section H of this technical report. The impacts of the selected plan are discussed in Section F,"Impacts of the Selected Plan."

METHODS OF FLOOD DAMAGE REDUCTION

CONTROL OVER THE LAND

Land use controls and other measures which can be implemented by local governments and individuals to guide future flood plain developments and lessen flood damage are equally as important as structural measures in preventing future flood damages. Among the various elements used to accomplish this are zoning ordinances, subdivision regulations, building codes, and sanitary regulations.

The Minnesota Legislature, in enacting the Flood Plain Management Act (Minnesota Statutes 1969, Chapter 590), recognized that flood plain management practices are necessary tools to protect human life and health and minimize property damages and economic losses. Under the Act, local units of government are required to adopt flood plain regulations whenever sufficient data are available to define flood plain and floodway areas along watercourses within their respective jurisdictions. (See Plate I-1.)

The basic purpose of flood plain regulation is not to prohibit, but to guide developments in flood plain areas consistent with nature's demands for the conveyance of flood flows and the communities' land use needs. Regulations that reflect the flood hazard can provide a reasonable degree of flood protection as part of the original construction. Consequently, flood damages, expenses, and inconveniences to the public can be minimized by flood plain zoning and other flood plain management practices.

The Statewide Standards and Criteria for Management of Flood Plain Areas of Minnesota, developed by the Department of Natural Resources, will serve as the basis for determination of compliance with the Flood Plain Management Act and the effectiveness of continued administration and enforcement of local flood plain regulations. State flood plain

management standards provide that delineation of the flood plain and floodway and enactment of flood plain regulations are to be based on the "regional" flood. The magnitude of this flood is consistent with the 100-year flood with ultimate urbanization as used in this report.

Until such time as the flood control project presently being studied is constructed, state policy requires that the municipalities adopt flood plain regulations based on existing flood levels rather than proposed flood levels. This policy was established to prevent persons from building in areas under the promise of future flood control measures which may never become a reality and to protect persons from flood damages that may occur in the time period that a project is being constructed. When the project is completed, local flood plain regulations may be modified to reflect the degree of flood protection being afforded by the project. Flood plain management ordinances and subsequent modifications are subject to review by the flood plain management section of the Department of Natural Resources.

The studies for this report included a comparison of several alternative means of solving the flood and other water-related problems in the Bassett Creek watershed. Based on these studies, the most practical and economical water resources development and management plan in the watershed provides for structural improvements in combination with flood plain regulations. The proposed plan of improvement and its beneficial effect on reducing flood stages and damages are described in Sections E and F of this technical report and the main report.

Flood plain regulations imply the adoption and use of legal tools by communities to control the extent and type of future development permitted in flood plains and are as important as structural measures in lessening flood damage. For these controls to be effective, public understanding of the general flood problem, the degree of risk, and the methods that can be used to control use of the land are essential. Various methods of regulating flood plain land use and development which will reduce or prevent future flood damages are possible and are discussed in subsequent paragraphs.

Designated Floodways

A designated floodway is the area of the channel of the stream and as much of the flood plain adjacent to the stream as is needed to convey flood flows or to provide temporary flood storage without causing excessive increases in flood stages. This area is usually subject to frequent flooding or fast-moving water. In a flood plain zoning ordinance, this area is commonly called the "floodway district". Development within the floodway district is limited to open space type uses having little or no flood damage potential and offering a minimum obstruction to the flow of flood waters. The affected localities are expected to cooperate with the Department of Natural Resources in selecting, evaluating, and designating a floodway for each study reach.

Once a floodway has been designated, the limits of the flood plain must be redefined reflecting anticipated increases in the elevation of the regional flood from further development allowed within the flood fringe areas, plus an appropriate amount of "freeboard" to establish a reasonable "flood protection level". (Minnesota Regulations NR 87 (c) and (e).)

Zoning

Zoning is the legal tool used to implement and enforce the detailed plans resulting from a planning program. It is used by communities, counties, and agencies of the state to control and direct use and development of land and property within their jurisdiction. Zoning insures the safekeeping of property for public health and welfare and the best use of available land. Division of communities into various zones should be the result of a comprehensive planning program for the entire area. Designated floodways may be zoned for passing flood waters and for other limited uses that do not conflict with that primary purpose. Zoning may also establish regulations for flood plain areas outside the floodways, but subject to inundation by flood waters. Such areas are in the flood plain fringe which is generally contiguous to high ground. In times of flooding,

these areas are associated with lesser flooding and slower flood water movement. Zoning ordinances refer to these areas as "flood fringe districts". Under criteria for flood plain regulations, land uses that are permitted under an existing zoning ordinance may continue to be permitted in the flood plain fringe areas (or flood fringe district). However, new buildings or additions to existing buildings and areas used for storing materials that are, in times of flooding, buoyant, flammable, or explosive are to be constructed or flood-proofed above the "flood protection elevation" for the particular area.

Subdivision Regulations

A subdivision can be defined as a tract of land divided into lots either for sale or building development. Subdivision regulations are used by local governments to specify the manner in which land may be divided. These regulations state the required width of streets, requirements for curbs and gutters, size of lots, elevation of land, freedom from flooding, size of floodways, and other points pertinent to the welfare of the community. Not only can public health and welfare benefit, but various municipal costs such as maintenance of streets and utilities can be reduced during flood periods. Subdivision regulations provide an efficient means of controlling construction in presently undeveloped flood plain areas. The following typical provisions, if added to regulations, would help prevent flood damage:

a. Show extent of the flood plain on subdivision maps.

b. Show floodway limits or encroachment lines.

c. Prohibit fill in the floodway that would restrict flow.

d. Require that subdivision roads be above the elevation of a selected flood level.

e. Require that each lot contain a building site with an elevation above a selected flood level.

Building Codes

A building code is a set of regulations adopted by a local governing body. The code sets forth standards for construction of building and other structures to protect the health, safety, and general welfare of the public. A well-written and properly enforced building code can effectively reduce damages to buildings in the flood plain. A few of the requirements which should be specified in a building code to reduce flood damages are:

a. Prevent flotation of buildings from their foundations by requiring proper anchorage.

b. Establish basement elevations and minimum first-floor elevations consistent with potential floods.

c. Require sufficient structural strength to withstand either water pressure or high velocity of flowing water.

d. Restrict use of materials which deteriorate rapidly when exposed to water.

e. Prohibit equipment that might be hazardous to life when submerged, such as chemical storage tanks, boilers, or electrical equipment.

In 1971, the Minnesota Legislature adopted an act providing for a state building code. After July 1, 1972, any county or city which had previously enacted a building code or subsequently enacts a code must adopt the state code. The state code does not apply to farm buildings and farm dwellings.

In January, 1974, flood-proofing regulations were incorporated into the state building code and are applicable to flood plain areas previously

designated by local zoning ordinances. The code adopted, in substance, a publication of the U.S. Army Corps of Engineers entitled "Flood-Proofing Regulations" with amendments to bring it in line with state flood plain management regulations.

Development Policies

Wise day to day policy and action decisions to prevent construction of streets and utility systems in undesirable areas will deter development in flood plains. Street improvements, schools, and other public facilities located elsewhere discourage flood plain exploitation and encourage development toward higher ground.

Bassett Creek Flood Plain Zoning

Because of recuring flood problems in the watershed, the Bassett Creek Flood Control Commission in the "Watershed Management Plan for Bassett Creek", delineated the flood plain resulting from a 100-year storm over the ultimately developed watershed. To implement the management plan, the following policies regarding flood plain regulation were adopted by the Commission:

1. The flood plain of Bassett Creek is defined as that area lying below the 100-year flood elevations as shown in the Management Plan of the Commission, or as subsequently revised due to channel improvement, storage site development, or requirements established by appropriate state or federal governmental agencies.

2. No land use of a type which would be damaged by flood waters is permitted within the flood plain.

3. Allowable types of land use which are consistent with the flood plain, such as recreation areas, parking lots, storage areas, agriculture, and other open uses, would be allowed only to the

extent that they would not increase flooding. Permanent storage piles, fences, and other obstructions which would collect debris or provide restriction to flood flows are not allowed.

4. Filling will generally not be allowed within that flood plain established in the Management Plan. If any municipality desires to fill within the established flood plain, such filling will require the approval of the Flood Commission and require provision for compensating storage and/or channel improvement so that the flood level shall not be increased at any point along the channel due to the fill.

5. Local governmental ordinances regarding flood plain regulation, as required under the State of Minnesota Flood Plain Management Act, will establish the guidelines for allowable flood plain development within each of the affected municipalities, with the provision that the proposed development in any area shall not conflict with the adopted Management Plan or Commission policy.

6. Expansion of existing non-conforming land uses within the flood plain will be prohibited.

To assist communities in the Bassett Creek watershed in the preparation and adoption of flood plain ordinances, the Commission prepared a model flood plain ordinance in 1974 to designate and regulate the use and development of the regional flood plains of Bassett Creek consistent with flood plain management criteria established by the Commissioner of the Minnesota Department of Natural Resources (Minn. Regs. NR 85 to 93). It is the intent of the model ordinance to establish a uniform flood plain management program for all municipalities having lands within the regional flood plain of Bassett Creek and to maximize the coordinated efforts of all members of the Bassett Creek Flood Control Commission in the management of the regional flood plain.

The regional flood plain consists of all lands within the watershed which are subject to flooding and which lie below the flood zone profile for Bassett Creek. To reduce flood damages and losses, uses susceptable to flood damage must be elevated or flood-proofed to the "Regulatory Flood Protection Elevation", an elevation not less than one foot above the flood plain elevation. The following uses are permitted in the flood plain to the extent that they are not prohibited by any other ordinance, provided they do not require structures, fill, storage of materials or equipment, and provided they do not adversely affect the efficiency or unduly restrict the capacity of the channels or floodways of any tributary to the main stream drainage ditch, or other drainage facility or system:

a. Agricultural uses, such as general farming, pasture, grazing, outdoor plant nurseries, horticulture, truck farming, forestry, sod farming or wild crop harvesting.

b. Industrial-Commercial uses such as loading areas, parking areas, and airport landing strips.

c. Private and public recreational uses, such as golf courses, tennis courts, driving ranges, archery ranges, picnic grounds, boat launching ramps, swimming areas, parks, wildlife habitat, game farms, fish hatcheries, shooting preserves, target ranges, trap, and skeet ranges.

d. Residential uses, such as lawns, gardens, parking areas, and play areas.

No temporary or permanent structure or fill for roads, levees, or other purposes, deposit, obstruction, storage of material or equipment, or other use are permitted, which acting alone or in combination with existing or reasonable anticipated uses would unduly affect the efficiency of the flood plain or unduly increase flood levels. Consideration of the effect of a proposed use shall be based on the assumption that there will

be an equal degree of encroachment extending for a significant reach on both sides of the stream. Any such use which increases the flood plain elevation by more than 0.5 foot per reach or for the cumulative effect of several reaches is deemed to unduly decrease the capacity of the channel or flood plain.

The following uses may be permitted in the flood plain upon the issuance of a special permit:

a. Filling is permitted by a municipality upon the approval of the Flood Control Commission and with the provision for compensating storage and channel improvement so that the flood level shall not be increased at any point along the channel.

b. Structural works for flood control, such as dams, levees, dikes, and flood walls may be erected, provided that they will decrease the flood damage potential in the area.

c. Public utilities, railroad tracks, streets, and bridges, provided they are designed to minimize increases in flood elevation and are compatible with the Management Plan of the Flood Control Commission. Flood protection for these facilities to the regulatory flood protection level shall be provided where failure or interruption of these public facilities would endanger the public health or safety or where such facilities are essential to the orderly functioning of the area. Where failure or interruption of service would not endanger life or health, a lesser degree of protection may be provided for minor or auxiliary roads, railroads, or utilities.

An obstruction or structure, or the use of a structure or premises, which was lawful before adoption of the ordinance, but which is not in conformity with the provisions of the ordinance may be continued subject to the following conditions:

a. No such obstruction, use, or structure shall be expanded, changed, enlarged, or altered in any way without complying, in all respects, with the ordinance, including, but not limited to the obtaining of all required permits and variances.

b. If such use of such obstruction or structure, or use of such premises, is discontinued for twelve consecutive months, any subsequent use of the obstruction, structure, or premises shall comply, in all respects, with the ordinance, including the obtaining of all required permits and variances.

c. If any nonconforming obstruction or structure is destroyed or damaged by any means, including floods, to the extent that the cost of repairing or restoring such destruction or damage would be 50 percent or more of the cost of re-erecting a new obstruction or structures of like kind and quality and of the same physical dimensions and location, then it shall not be reconstructed, except in full compliance, in all respects with the provisions of the ordinance including the obtaining of all required permits and variances.

As part of the ordinance, enforcement and penalty measures are stipulated. "Any person who violates any provision of this ordinance or fails to comply with any of its terms or requirements is guilty of a misdemeanor punishable by a fine of not more than $300 or imprisoned for not more than 90 days, or both. Each day such violation continues shall be considered a separate offense. Every obstruction or use placed or maintained in the flood plain in violation of this ordinance is hereby declared to be a public nuisance, and creation thereof may be enjoined, and the maintenance thereof abated by appropriate judicial action. Nothing herein contained shall prevent the City from taking such other lawful action as is necessary to prevent, remedy or remove any violation."

Of the nine communities in the watershed, Golden Valley, Minnetonka, Minneapolis, Medicine Lake, New Hope, Robbsindale and St. Louis Park currently have flood plain ordinances in effect similar to the model ordinance, and the other communities are in the process of adopting flood plain ordinances.

FLOOD PROOFING

Flood proofing is a combination of structural changes and adjustments to properties subject to flooding, primarily meant to reduce or eliminate flood damages. Although more simply and economically applied to new construction, flood proofing is also applicable to existing facilities. It has promise in one or more of the following situations:

a. Where moderate flooding with low stage, low velocity, and short duration is experienced.

b. Where the traditional type of flood protection is not feasible.

c. Where individuals desire to solve their flood problems without collective action, or where collective action is not possible.

d. Where activities dependent on stream locations need some degree of protection.

e. Where a resource manager desires a higher degree of protection than that provided by a flood control project.

Many different flood proofing measures have been recognized and studied. The names given most of them are self-explanatory. Included in these measures are the following items:

Seepage control	Watertight caps	Appliance protection
Sewer adjustment	Proper anchorage	Utility adjustments
Permanent closure	Underpinning	Roadbed protection

Openings protected	Timber treatment	Elevation or raising
Interiors protected	Deliberate flooding	Temporary removal
Protective coverings	Structural design	Rescheduling
Fire protection	Reorganized use	Proper salvage

A sketch showing some flood proofing techniques is on Plate I-2. The following paragraphs describe some of the more applicable measures available for flood-proofing existing residential properties.

Because of pervious foundation soils and high ground water table in some areas of Bassett Creek, seepage control will remain a problem even with the proposed flood control works in place. However, foundation walls could be made water-tight to minimize water infiltration through cracks and crevices in the walls. In buildings under construction, this could be accomplished through use of waterproof membranes and seals. Construction joints could be protected by use of a neoprene or similar water-stop. Existing masonry or stone foundations are more difficult to water-proof, particularly if the mortar joints have deteriorated with age. Sealing of walls to prevent seepage could be accomplished in many cases, however, by coating them, preferably on the exterior, with hydraulic cement, epoxy paint, or other similar water-proofing materials. However, sealing and waterproofing walls increase the hydraulic forces acting on the walls, unless drainage provided by cracks and crevices prior to sealing is provided by other means. Sometimes the wisest course is to permit seepage through the wall and then control it by a floor drain and sump pump. Existing cracks and leaks in walls provide the most practical form of drainage to relieve pressure, and in some cases, this drainage could be supplemented by drilling holes through the walls. Structural and hydraulic analyses of alternative designs and associated cost estimates would enable the designer to choose the most suitable means of controlling seepage at a given building. A sump and pump system could be employed to help protect the subsurface part of a building. The pump could be designed to accept storm and seepage flows and pump them to a point above the flood waters. The sump should be open to the soil at

the bottom and to atmospheric pressure at the top within the basement. This would provide a fail-safe feature, in that power or pump failure would allow water to flood the basement and balance the outside flood-induced pressures upon the basement walls and floor slab. As an alternative, a prearranged program of deliberate flooding with clean water could be employed to minimize the cost of cleanup after a flood.

Most existing subdrains, whether connected to sewage systems or not, are subject to backflow and high pressures during floods. Since these high pressures could burst the usually encountered clay pipe subdrains and endanger basement walls and floors, some device such as a gate valve must be provided for protecting or isolating subdrains around buildings from these high pressures. There are several alternative methods for controlling backflow through sewers. One method would be to install a main valve where the sewer is strong enough to resist flood-induced pressure and where all possible reverse flows can be stopped. (See Locations A and B in Figure I-1, Plate I-3.) This valve should be designed to accommodate grit and other materials which could lodge in it. If the pipe is of sufficient strength, an alternative would be to install separate valves on all basement fixtures and floor drains (Figure I-1). These valves could be inflatable rubber plugs or a similar type of mechanically expandable rubber plug. Valves designed for low pressure (20 pounds per square inch and less) could be installed in drain lines of fixtures which are below design water levels. In either of the above alternatives, it would be necessary to provide adequate sump pumps to handle any leakage. Figure I-2, shown on Plate I-3 presents another alternative for controlling sewer back-up. This alternative provides for outletting all floor drainage, appliance drainage, drain tile flow, and any seepage that might enter the building to a sump pump. The pump would lift the drainage to an elevation above the design flood on a permanent basis. By thus eliminating all gravity sewer drains, the problem of flooding backflow could be eliminated and a subsurface area permitted to function during floods.

A useful guide, "Introduction to Flood Proofing", prepared by the Center for Urban Studies, University of Chicago, under the sponsorship of the Corps of Engineers, is available upon request. It presents many helpful suggestions and briefly outlines and illustrates the possibilities of this approach. Another guide, "Flood Proofing Regulations", prepared by the Corps of Engineers, is also available upon request.

Flood proofing of suitable structures and evacuation of others in the flood plain as an alternative for reducing flood damages in the Bassett Creek watershed is generally not feasible because of the extensive existing development in the flood plain. However, flood proofing of some structures and evacuation of others are included as elements in the selected plan to the extent that other measures are not feasible.

FLOOD WARNING-FORECASTING

Because of the highly technical nature of the work and the interstate factors that must be considered, the Federal Government has provided leadership in developing and operating the major flood forecasting system. The following is a statement from the National Oceanic and Atmospheric Administration of the National Weather Service on the flood warning program in the Bassett Creek watershed area:

> The National Oceanic and Atmospheric Administration (NOAA) National Weather Service provides no specific flood stage forecasts for the Bassett Creek watershed, Minnesota. The technology of accurate river and flood forecasting is dependent upon adequate and timely rainfall and river stage reports, and it is even more essential that such basic data be available, particularly rainfall reports for flood-prone areas. The Bassett Creek watershed is in the Minneapolis River District. Current funding restraints prevent National Weather Service operation of the relatively dense networks required for specific stage forecasts for the multitude of small streams. However, this problem has been resolved as follows:
>
> > Hennepin County, Minnesota, is in the service area of the Minneapolis NWS Office. In addition to the routine two-a-day weather forecasts, special forecasts of severe storms and general flash flood warnings for small streams in the county are issued as required by meteorological events. Hennepin County

is within the range of the radar at Minneapolis which is capable of detecting the area and movement of intense precipitation. Radar observations of intense rainfall and projection of storm movement give some lead time for flash flood warnings, which are promptly disseminated to all news media and local officials by the best communications available, including telephone.

TEMPORARY EVACUATION

Temporary evacuation of persons and property from the path of flood waters is another important aspect of flood loss reduction. When a flood is expected:

a. Buildings can be evacuated.

b. Materials can either be raised above flood waters or removed to higher ground.

c. Emergency protective measures can be undertaken.

d. Flood fighting and relief agencies can be activated.

Severe thunderstorms centered over Bassett Creek watershed can produce flooding in a matter of hours allowing little time for evacuation of flood plain occupants and personal contents and the construction of emergency measures. Therefore, reliance on these measures of reducing flood damages in the watershed would be impractical.

PERMANENT EVACUATION

Permanent evacuation of developed areas subject to inundation involves purchase of lands (through the power of eminent domain, if necessary), removal of improvements, and relocation of the population from such areas. Lands acquired could be used for agriculture, parks, or other purposes that would not interfere with flood flows or result in material damage from floods.

OPEN SPACES

Great emphasis is being placed on the growing need for areas for recreational and other open-space uses. Areas adjacent to streams and other bodies of water have a natural attraction and are readily adaptable to recreation. Lands not suitable for facilities requiring permanent structures could be utilized for parks, picnic areas, and playgrounds. A number of localities throughout the country are using flood plains for such purposes and are reaping secondary benefits from flood damage prevention. Federal grants have been made to assist communities with acquisition of such open spaces when it is linked with a comprehensive planning program.

WARNING SIGNS

A method which may be used to discourage development is the erection of flood warning signs in the flood plain area, or the prominent posting of previous high-water levels. These signs carry no enforcement, but simply inform prospective buyers that a flood hazard exists.

BUILDING FINANCING

Very little building is carried on without financing. Therefore, both Federal and private lending institutions are able to exercise some control over flood plain development by denying mortgage guarantees and funds to subdivision and private builders. The Flood Disaster Protection Act of 1973 (Public Law 93-234) requires local governmental participation in the National Flood Insurance Program as a prior condition for loans to private citizens from lending institutions, which are insured or regulated by Federal agencies. All communities in flood prone areas have until July 1, 1975, or one year after the issuance of a Flood Hazard Boundary Map to become eligible for participation in the National Flood Insurance Program. Properties that are in violation of state or local land use regulations adopted after the completion of the flood hazard determination would not be eligible for flood insurance coverage and, therefore, could not receive federally guaranteed loans.

FLOOD INSURANCE

Flood insurance, if established on a sound and equitable basis, could relieve the financial burden of flood damages and provide another supplement to programs for reducing flood damage. However, insurance rates should realistically reflect the flood risk to discourage improper development of flood plains. The National Flood Insurance Act of 1968 (PL 90-448) as amended, established a program of Federal assistance for flood insurance to be related to a unified national program for flood plain management. The flood insurance program makes available, under Federal auspices, specified amounts of flood insurance previously unavailable from private insurers. The act requires that state and local governments adopt and enforce regulatory measures that will guide land development in flood prone areas to avoid or reduce future flood damages.

As of June, 1975, all of the communities in the Bassett Creek watershed, except Medicine Lake, had applied to the Department of Housing and Urban Development for the flood insurance program and are eligible under the emergency program. Under this program, flood insurance with subsidized premium rates is available on structures in amounts up to $35,000 for single family dwellings and up to $100,000 for multi-family and non-residential properties. Insurance on contents is available to a maximum of $10,000 per unit for residences and $100,000 for non-residential units. After flood insurance rate studies have been completed for these communities, coverage up to double the above amounts will be available at actuarial rates. As of June, 1975, a flood insurance rate study was underway in St. Louis Park, and flood insurance rate studies were proposed for Minneapolis, Robbinsdale, Crystal and Plymouth.

The 1973 Flood Insurance Act changed the program in that newly constructed or substantially improved buildings in the sepcial hazard area may still obtain flood insurance at subsidized rates until the rate study is complete. Another change in the law is that all building in the special flood hazard area in a participating community must be covered by flood insurance after 1 March 1974 to be eligible for any form of mortgage loan

from a federally insured or supervised bank, a savings and loan association, or from any Federal agency. After 30 June 1975, or one year after a community's initial notification of being flood prone, no loans will be approved in designated special flood hazard areas unless a Flood Insurance Policy is purchased.

Flood insurance does not prevent flood damages but does assist in reimbursing affected property owners for losses sustained from flood damages. Flood insurance is most effective when utilized in conjunction with flood plain regulation and other measures. If insurance is properly admistered, all premiums except that portion used for administration would be returned to property owners through payments for damages. Thus, the costs of insurance protection, if profit margins are small, only slightly exceed the benefit to the insured.

BRIDGES

Community expansion brings about the desire for more stream crossings. From a construction standpoint, perhaps the most economical method of providing crossings consists of roadways on earth embankments, with small bridges or culverts to pass streamflows. However, this is often the least desirable from a flood damage point of view. If the structure is kept at a low elevation, it is frequently flooded and fails to serve its intended purpose. If the roadway is kept high above the flood plain, it will act as a dam and increase flood stages upstream unless the waterway opening is adequate. With the proposed plan of improvement, the local sponsor will be responsible for maintaining the flow capacity of the creek which includes providing adequate waterway openings, clearances, and roadway heights above flood flows for all future crossings. Under Minnesota State Statutes, all stream crossings require a permit from the Department of Natural Resources. Permit applications are reviewed to insure that the waterway openings are adequate to pass stream flows without significantly increasing upstream flood stages.

PERMANENT EVACUATION AS AN ALTERNATIVE TO PROPOSED STRUCTURAL IMPROVEMENTS

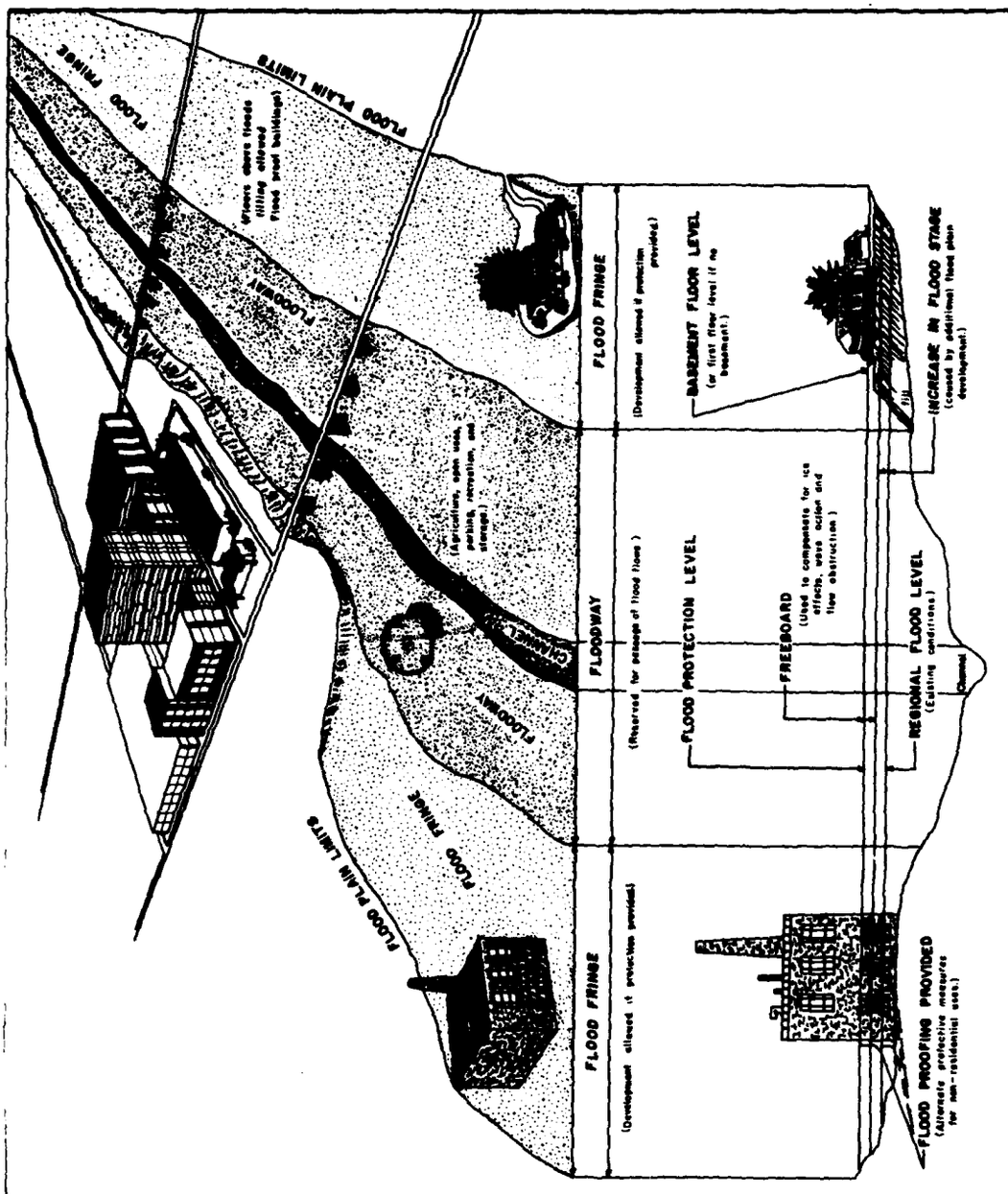
As an alternative to structural means of regulating or containing flood flows, permanent evacuation of the Bassett Creek flood plain and permanent conversion of land use were considered. This would involve acquisition of some 2,687 acres of land by purchase, evacuation, and relocation of over 220 homes and 18 commercial establishments, and conversion of all flood plain lands within the watershed to less flood damage-prone uses. Preliminary estimates indicated that economic costs for relocation would approximate 58 million. However, the additional economic costs associated with the foregone urban uses of flood plain lands were not evaluated. Because of its economic infeasibility, and because other alternatives were found to be less costly and far more practicable and acceptable by local interest, the permanent evacuation plan was not considered further. While permanent flood plain evacuation is economically infeasible and unacceptable by local interests for a watershed plan, small areas can be evacuated without severe adverse effects. These areas include small areas or individual homes or businesses which must be removed to construct flood control works or which cannot be practically or economically protected by other measures.

FLOOD PLAIN REGULATION AS AN ALTERNATIVE TO PROPOSED STRUCTURAL IMPROVEMENTS

High residual flood damages remain with existing flood plain regulations, and it is recognized that flood plain regulation alone is not the optimum flood damage reduction plan for the Bassett Creek watershed. Flood plain regulation has been considered as a supplement to, rather than a substitute for, other flood damage reduction measures. Flood plain regulation in the Bassett Creek watershed has been limited to enacting building codes requiring flood-proofing for important and costly future facilities; eliminating basements of proposed new residences; elevating first-floor levels of proposed new structures, where practicable, above regional flood levels; gradually converting land use; and gradually eliminating nonconforming uses within the floodway.

FLOOD PLAIN REGULATION AS A SUPPLEMENT TO
PROPOSED STRUCTURAL IMPROVEMENTS

Comprehensive planning for the Bassett Creek watershed has taken into account the flood hazard which will exist until the proposed flood control measures are in place. Flood plain information, including flooded area maps and corresponding water-surface profiles for the regional flood including in the 1972 "Watershed Management Plan" and the 1974 "Feasibility Report for Flood Control", is being used by community officials and the Bassett Creek Flood Control Commission as a guide for planning developments in the interim period until proposed improvements can be constructed. When the proposed structural flood control measures are constructed, current regulations will be amended to reflect the conditions modified by the structural measures. In addition, coordination with the Flood Insurance Administration will be necessary to enable them to adjust their flood insurance premium rates and revise their flood hazard maps. It is also recommended that during the interim period, all developments be constructed in accordance with provisions of the State Flood Plain Management Act.

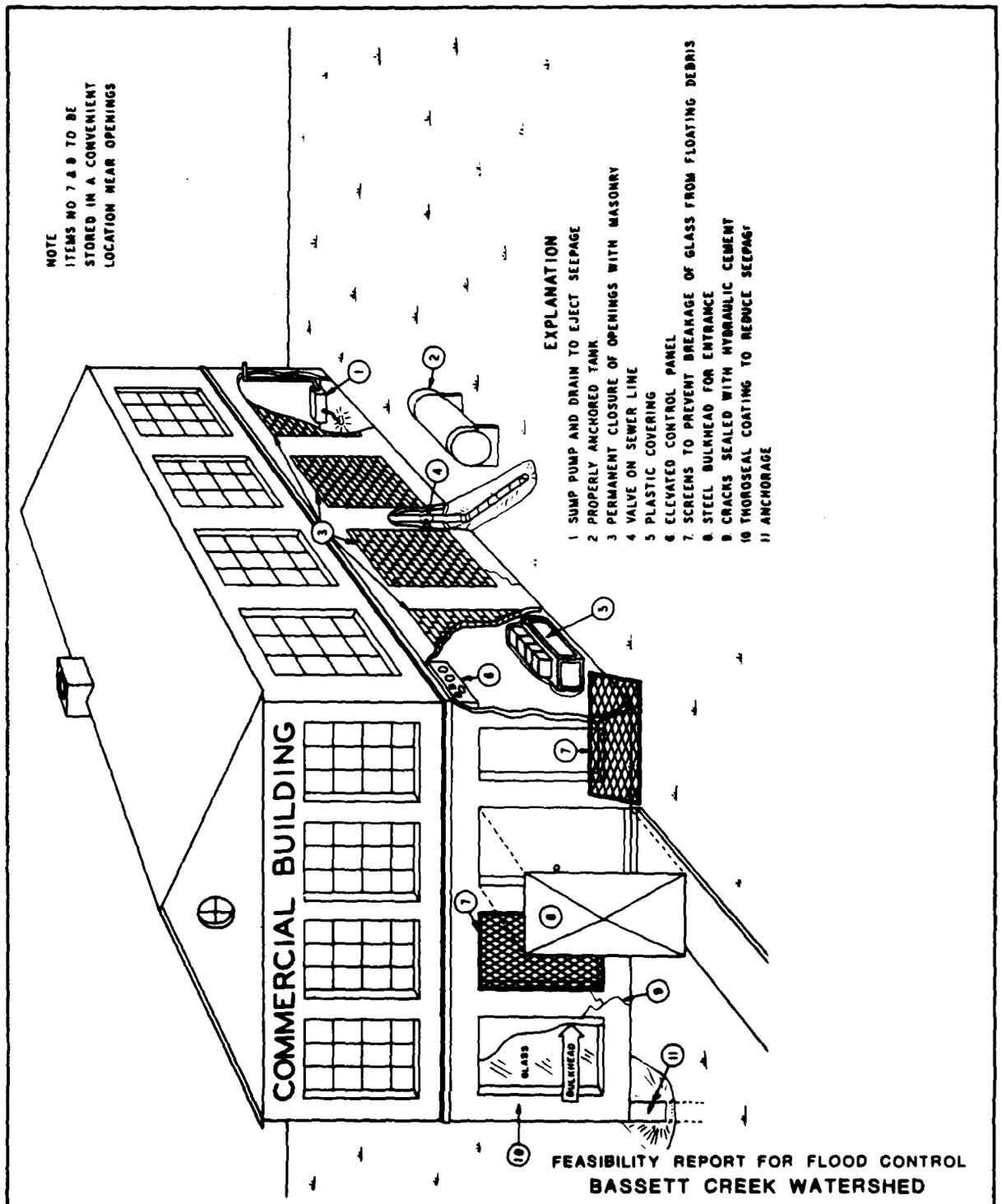


FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

FLOOD PLAIN SCHEMATIC

ST. PAUL MINN. DISTRICT
FILE NO. M 35.1-R-5/47 MARCH 1976

PLATE 1-1



FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

A FLOOD PROOFED STRUCTURE

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/48 MARCH 1976

PLATE I-2

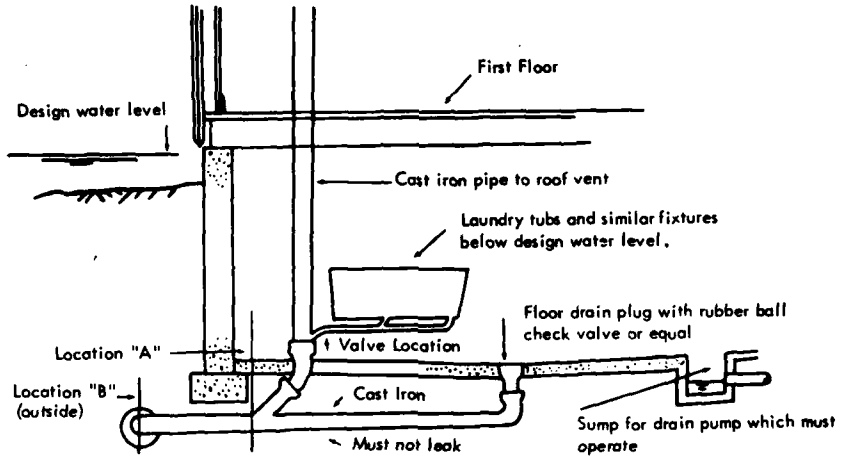


FIGURE I-1 - ALTERNATIVE LOCATIONS FOR CUTOFF VALVES ON SEWER LINES

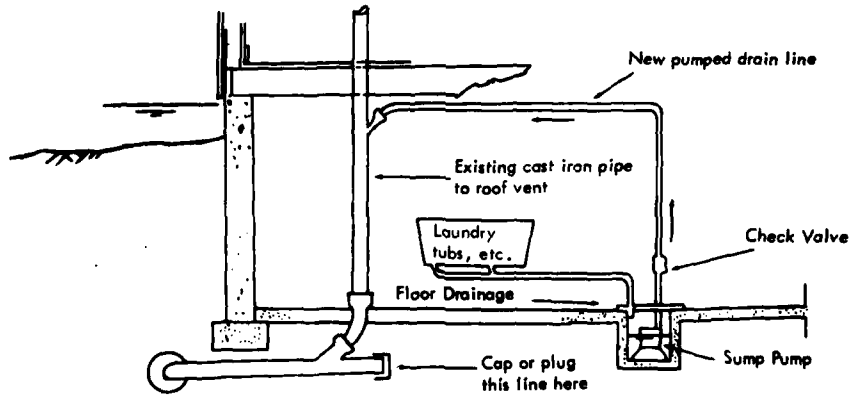


FIGURE I-2 - ELIMINATION OF GRAVITY FLOW BASEMENT DRAINS

FEASIBILITY REPORT FOR FLOOD CONTROL
BASSETT CREEK WATERSHED

METHODS FOR CONTROLLING SEWER BACKUP

ST. PAUL, MINN. DISTRICT
FILE NO. M35.1-R-5/49 MARCH 1976

PLATE I-3

[illegible] GROVE, MINNESOTA

FEASIBILITY REPORT FOR FLOOD CONTROL

COORDINATION WITH OTHER INTERESTS AND PUBLIC INVOLVEMENT

APPENDIX 2

U. S. ARMY CORPS OF ENGINEERS

ST. PAUL, MINNESOTA

APPENDIX 2

COORDINATION WITH OTHER INTERESTS AND PUBLIC INVOLVEMENT

Throughout the study, coordination among Federal, State and local interests played an important role in the development of a comprehensive resources plan for the Bassett Creek watershed. Input concerning water resource management alternatives in the Bassett Creek watershed was received from Federal, State and local agencies during early phases of the study and their views were considered during the continuous planning process. The watershed contains portions of nine municipalities, Crystal, Golden Valley, Medicine Lake, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale, and St. Louis Park. The problems and needs of the various communities differ significantly because of their diversity of character. Also because of the developed nature of the watershed and the number of communities involved, coordination was maintained with a substantial number of interested individuals, groups and organizations.

The first public hearing on the flood problems in the Bassett Creek watershed was conducted by the St. Paul District, Corps of Engineers on 30 January 1963. At that time, local interests indicated that they favored retaining flood runoff in temporary storage and ponding areas and in the natural lakes of the watershed to control flooding. They objected to any flood control plan which would adversely affect the natural beauty of Bassett Creek. Between 1963 and 1969, the Golden Valley Flood and Drainage Committee actively studied the water resource related problems of the Bassett Creek watershed. On 19 May 1972, a public hearing was held by the Bassett Creek Flood Control Commission on the possible adoption of a watershed management plan for Bassett Creek. Generally, local interests supported the policies of the Commission, as outlined in the Management Plan, to control future development in the flood plain and in potential flood storage areas until a flood control plan for the watershed could be selected. At that hearing local interests emphasized the need to involve the public in the plan selection process.

In 1973, during the preliminary feasibility study, public meetings were held in municipalities throughout the Bassett Creek watershed. At these meetings, past, current and possible future flood problems of the watershed were discussed. The objectives of interested citizens and organizations and their views of current and future problems and needs were solicited. The importance of social, environmental and community factors in the identification and evaluation of alternative flood control measures were apparent. During the preliminary studies, several communities organized informal citizen advisory groups to assist in the evaluation of the problems and needs of the public. These interested citizens assisted in keeping the public informed of the status of the study and provided a vehicle through which public input on the alternative solutions could be obtained.

Upon completion of the preliminary feasibility study, a report presenting the results of the study was distributed for comment to interested Federal, State and local interests. This interchange of information with various agencies and local interests assisted in establishing workable combinations of alternatives and in narrowing the range of feasible alternatives.

Upon initiation of the studies for this feasibility report, it became obvious that because of the diversity of the communities in the watershed, the differing problems and needs of the communities and the large number of interested citizens, individual workshop meetings should be held in each of the affected communities. The first workshop meeting was held in Minneapolis on 26 February 1975. Past, current and possible future activities in the Bassett Creek watershed, the need for community input and the identification of the water and land resource problems and possible solutions as perceived by the community were emphasized. As a result of this meeting, the Minneapolis Task Force on Bassett Creek was formed. The major emphasis on the Task Force was to evaluate all alternative solutions to the flooding problem which could also focus attention on the creek corridor through Minneapolis and increase its value as an asset to the residents and businessmen in the neighborhoods adjacent to Bassett Creek and to the city as a whole. The Task Force prepared and distributed

an outline of their proposed planning efforts and a questionnaire to determine the importance of various activities along the creek corridor to residents of the area. An implementation plan to focus attention to the creek corridor was also prepared by the Task Force.

Workshop meetings were also held in each of the other communities of the Bassett Creek watershed except Medicine Lake. These meetings were held with city planning commissioners, environmental commissions, organized citizen advisory groups and groups of interested citizens and other local interests. All meetings included the information evaluation and discussion of alternatives and the identification of the principal concerns of varying interests. Generally, the public involvement program has:

1. Established a need to protect the health and safety of the residents of the watershed.

2. Emphasized the need to minimize the effects of the plan on the existing aesthetic and environmental qualities of the creek or to enhance the existing environmental and aesthetic qualities.

3. Indicated a desire to develop the recreational potential of the creek corridor.

4. Indicated a desire for feasible combinations of structural and nonstructural measures to minimize adverse impacts of the alternatives on the residents of the watershed.

In addition to the public workshops, several articles discussing the possible alternatives were published in local suburban newspapers and a synopsis of the various alternatives was prepared and distributed to local interests.

A draft Bassett Creek watershed feasibility report was completed in August 1975 and distributed to all interested Federal, State and local agencies and to interested citizens for their review and comment. The

draft report identified a selected plan of improvement for the Bassett Creek watershed. A summary sheet of the significant comments received with related discussion is shown on the following figure.

Agency Comments on the Bassett Creek, Draft Feasibility Report for Flood Control

Agency	Comments	Response
U.S. Department of the Interior National Park Service	1. Our Midwest Archaeological Center concurs with the Minnesota Historical Society's statement that an archeological survey of the project area is needed.	1. An archeological survey of the project area has been conducted and the report has been revised to reflect the results of the archeological survey. In addition, the Minnesota Highway Department is currently conducting an archeological survey as part of their environmental impact statement for the highway project.
U.S. Department of the Interior Fish and Wildlife Service	1. The relocation of several homes is a positive approach toward solving long-term floodplain problems. Perhaps several of the homes to be flood-proofed could also be relocated. With a benefit/cost ratio of 1.9 some additional costs resulting from home relocation may be acceptable. 2. The use of parks and golf courses as temporary flood water storage area is an acceptable and appropriate function of the floodplain. 3. The 20-acre, Type IV and/or Type V wetland "ponding" area created at the inlet to the proposed conduit would provide valuable habitat for "urban" waterfowl, particularly the expanding Canada goose population. 4. We support the views expressed by citizens of the watershed at the several public meetings regarding the unacceptability of channel modifications and realignments and that the creek should be left in its existing state wherever possible. 5. The Metropolitan Council of the Twin Cities area and the City of Minneapolis have expressed interest in an open space proposal calling for the development of a Bassett Creek Parkway similar to the open-space channel corridor of outlet alternate E. Consideration of this proposal may depend on the results of the Open Conduit Feasibility Study being conducted by the City of Minneapolis. The total development of a parkway and open conduit would protect and enhance the natural environment of the creek. We urge that a final decision on the recommended plan not be made until after this study has been completed and reviewed. 6. The feasibility report indicates that the water quality of Wirth Lake has deteriorated significantly and that the process is accelerating. Water quality testing on the stream should continue in an effort to locate and abate water pollution sources. Alternatives such as "no action" or channelization would further degrade the lake's water quality and would be unacceptable. 7. The repoft indicates that, in general, the recreational facilities available to the general public in Hennepin County are adequate to meet existing needs. The future recreational needs of the area should be investigated further and discussed in the report. 8. The report does not clearly indicate the diversity of fish and wildlife species present in the study area. 9. A 0.5 foot reduction in the 100-year flood level of Medicine Lake would reduce the flood damage potential around the lake. Unfortunately, the lowering of the lake during the spring flood period would also result in the loss of natural northern pike spawning areas along the edge of the lake. We recommend that a controlled northern pike spawning in combination with a carp barrier be constructed on the lower one mile of Plymouth Creek to compensate for the loss of northern pike spawning areas around the lake due to the proposed lowering of the 100-year flood level. The development should be closely coordinated with the Minnesota Department of Natural Resources. 10. The proposed underground conduit outlet to the Mississippi River should be designed as a fish barrier to prevent movement of fish upstream from the river. A barrier in the conduit will allow existing carp populations to be controlled by the application of selective carp toxicant.	1. While floodplain evacuation is a positive approach to solving the long-term flood problems more extensive evacuation in the Bassett Creek watershed would result in severe adverse social impacts and is socially unacceptable to the people being protected. Only in those areas where individual homes or businesses must be removed to construct flood control works or where they cannot be economically protected by other measures is floodplain evacuation a viable solution to the flood problems in the Bassett Creek watershed. 2. Comment acknowledged. 3. Comment acknowledged. 4. Comment acknowledged. 5. The Open Conduit Feasibility Study being conducted by the City of Minneapolis may or may not find the open space proposal feasible. However, city officials view the open space proposal as a long-range planning proposal since it would take several years to acquire the necessary right-of-way and to complete the plans. Delay in recommending a plan for the reduction of flood damages would allow the social and economic burden of flooding on residents of the watershed to continue, particularly in the commercial and industrial area near the inlet to the existing conduit. Should the existing conduit fail during a major flood event, catastrophic flooding would occur in the vicinity of the conduit inlet. Construction of a new conduit in cooperation with the Minnesota Highway Department provides a dual purpose facility at a significant cost saving to the taxpayers when compared to separate facilities. Delay in recommending a plan for the Bassett Creek watershed would result in the loss of the opportunity to construct this dual purpose facility which would provide immediate flood damage reduction and significantly reduce the threat of catastrophic flooding in the vicinity of the conduit inlet. Construction of the new conduit in cooperation with the Minnesota Highway Department would not preclude the future development of an open space-open channel corridor should the Open Conduit Feasibility Study find the proposal to be feasible and the proposed new conduit could continue to function as a flood control structure to reduce the threat of flooding in the City of Minneapolis. 6. The water quality monitoring program initiated by the Bassett Creek Flood Control Commission in 1972 has identified general water quality problem areas throughout the watershed. The water quality monitoring program currently being undertaken by the Bassett Creek Flood Control Commission is intended to locate the sources of contamination and, with the cooperation of the Minnesota Pollution Control Agency, improve the existing water quality throughout the watershed including Wirth Lake. 7. During the course of this study, parks and recreation directors from each of the municipalities except Medicine Lake were interviewed. The purpose of these interviews were to identify the recreational resources of the watershed as well as any existing or future unmet recreational needs were identified. In response to these unmet recreational needs in the City of Minneapolis, the recommended plan includes approximately 10,000 feet of bikeway and walk path along the creek corridor including a link to nearby Bryn Mawr Meadows Park. During advanced design studies, coordination will be maintained with local, regional, state and Federal agencies to assure that any future needs which can be satisfied as part of the project will be identified. 8. Report revised to reflect comment. 9. Further coordination with representatives of the Fish and Wildlife Service and the Minnesota Department of Natural Resources resulted in a revision of the proposed outlet of Medicine Lake so that flood levels resulting from runoff events of a magnitude less than a 20-year frequency would not be lowered. 10. It is intended that the proposed new conduit be designed to provide an effective fish barrier. It became obvious during the early stages of the study that a fish barrier to prevent the upstream migration of carp and other undesirable rough fish from the river would enhance the watershed's fisheries.
U.S. Department of Commerce National Oceanic and Atmospherice Administration	1. Flood forecasting-flood warning services are available through the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Forecast Office in Minneapolis, Minnesota. An appropriate discussion of these services should be in the report.	1. Flood forecasting-flood warning services are discussed under No Action--Maintain Base Condition (Alternate 1) and this discussion has been revised to reflect the full range of services available to the Bassett Creek watershed through NOAA's National Weather Service Forecast Office in Minneapolis, Minnesota.

Agency Comments on the Bassett Creek, Draft Feasibility Report for Flood Control

Agency	Comments	Response
U.S. Department of the Interior Geological Survey	1. The report does not evaluate the impacts of the various phases of the proposed project on water table conditions in the glacial drift nor on artesian heads in the sandstone and dolomite aquifers. Effects on the tunneling and channelization on groundwater hydraulics, storage, water levels and possibly local underflow in artesian aquifers should be considered.	1. Report revised to reflect comment.
U.S. Department of the Interior Bureau of Outdoor Recreation	1. The report should make reference to the Twin Cities Level B Study. Any proposed developments should be coordinated with the final Level B report to assure compatibility with the recommendation of the study. 2. The selected plan involves flood storage on Jordan Park (Bassett Creek Park) and Brookview Community Park. Portions of these parks have been acquired with monies from the Lake and Water Conservation Fund (L&WCF) administrated by the Bureau of Outdoor Recreation (Project 27-00600, Jordan Park and Project 27-00267, Brookview Recreation Area). The report should indicate L&WCF involvement in these parks. 3. The report states that an earthern embankment will be constructed along the eastern boundary of Jordan Park (Bassett Creek Park). The dimensions of this embankment (height, number of acres of park land required) should be indicated. 4. The use of Bassett Creek Park and Brookview Community Park for flood storage may constitute a change in land use. Any changes in land use within a park funded with Lake and Water Conservation Funds creates a Section 6(f) conflict. The possibility of a Section 6(F) conflict should be discussed and resolved.	1. Report revised to reflect comment. 2. Comment acknowledged. 3. The proposed earthern embankment would be constructed to the east of the eastern boundary of the park as shown on Plate H-28 and no park land would be required for the embankment. Plate H-28 shows the plan, profile and typical sections of the earthern embankment. 4. Further coordination with the Minnesota State Planning Agency and the Bureau of Outdoor Recreation has revealed that the use of Bassett Creek Park and Brookview Community Park for flood storage does not constitute a Section 5(f) conflict.
U.S. Environmental Protection Agency	1. Although the proposed project is primarily concerned with flood control in the watershed, the Feasibility Report is somewhat lacking in the attention it gives to water quality. The report does not inventory industrial and municipal point discharges or non-point sources of pollution within the Bassett Creek watershed. With continued urban development expected in the watershed, consideration should also be given to the environmental impact of increased urban runoff upon water quality. 2. It is not clear from the report whether or not structural measures will adversely affect the natural purifying capacities of the streams on which they are proposed. These structural measures include those that will significantly alter channel widths, depths, velocities and discharges. 3. The effect of the selected plan on groundwater quality is not included in the report. In view of the fact that groundwater quality in the watershed is generally deteriorating, the effects of implementing those aspects of the selected plan which should tend to increase groundwater absorption would be reported. Additionally, the report should discuss the ramifications, if any, of the proposed project upon the water table in areas of the watershed adjacent to construction sites. 4. We agree with local citizens and the Feasibility Report that extensive channel modifications within the watershed are undesirable and unnecessary. However, some channel widening and excavation are nevertheless proposed in the selected plan, and, at this stage in planning, the report should address measures which will be taken to minimize and control pollution from construction activities. Since a considerable amount of earth materials will be displaced during excavation and channel widening, it will be imperative to know whether or not bottom and stream bank sediments are polluted. Excavation of polluted materials could have a serious degrading impact upon water quality and upon potential disposal sites. 5. We presume that the 8, 8-1/2, and 10 foot diameter conduits proposed for the section between Irving Avenue North and the Mississippi River will be capable of accommodating the discharge of a 100-year flood. However, the maximum discharge this conduit system can accommodate should be stated within the report. 6. We appreciate recreational improvements and beautification measures proposed in conjunction with flood protection, and also the attention the report directs toward floodplain regulation. Good floodplain management should definitely be required in conjunction with the proposed project. The model ordinance of the Bassett Creek Flood Control Commission is straightforward and sound in its approach to floodplain regulation. But provision for enforcement of floodplain regulations is less clear, and the attitudes of individual communities and other private interests within the watershed should be discussed. Potential conflicts and unconformities should be addressed in the planning stage. A contradiction appears to exist between proposed floodplain regulations and anticipated future land use in the 100-year floodplain (Appendix 1, B-60). Specifically, Table 25 indicates that residential, commercial and industrial land use is expected to increase sharply within the 100-year floodplain. Such development would have to be viewed as having a degrading impact upon the environment. In summary, the implementation of floodplain regulations needs to be clarified.	1. An inventory of point and nonpoint sources of pollution within the Bassett Creek watershed and an evaluation of the effect of increased future urban runoff on water quality are beyond the scope of this study. However, the Bassett Creek Flood Control Commission is conducting studies of the effect of increased urban runoff on the creek, lakes and ponds in the watershed as is currently evaluating alternate methods of minimizing the effect of increased urban runoff on water quality. In addition, the Commission is, with the cooperation of developers, evaluating the treatment of runoff from a large commercial area in the watershed. The Commission is also currently monitoring the water quality of the creek in order to locate point and nonpoint sources of contamination within the watershed. 2. The natural purifying capacity of the creek from the Mississippi River to the inlet of the conduit will be improved because of increased velocities and the proposed drop structure in the conduit. Normal and low flows in the remainder of the watershed would not be significantly altered and, therefore, its existing natural purifying capability would not be affected. On the main stem of Bassett Creek, flood discharges are reduced between the conduit entrance in Minneapolis and Brookview Community Park in Golden Valley. On the North Branch of Bassett Creek, channel discharges during flood periods are increased between Bassett Creek Park and 36th Avenue North, however, these floodwaters are then temporarily stored in Bassett Creek Park. 3. Report revised to reflect comment. 4. In areas where the creek is intermittant, construction activity and restoration can be completed during periods when there is no flow in the creek. In other areas, construction could be accomplished during periods of low flow and the creek diverted by pumping or other measures. During advanced planning stages, soil samples will be taken in the areas to be excavated to evaluate the potential effect of excavation on water quality and to determine if special disposal techniques are required for the excavated materials. 5. Report revised to reflect comment. 6. As discussed in Appendix 1-1, Minnesota Statutes require communities to adopt and enforce floodplain management regulations six months after notification that sufficient information is available to do so. As also discussed in the report, all of the communities in the Bassett Creek Watershed have adopted regulations or are in the process of adopting them. The ordinances adopted by the communities have been reviewed and approved by the Minnesota Department of Natural Resources in accordance with State statutes. It is not the intention of floodplain regulations to prohibit development, but rather guide development in the floodplain areas. Development of floodplain areas for residential, commercial and industrial purposes is possible if these developments are flood-proofed or elevated to non-damagable levels and provided they do not significantly increase flood damage potential in other areas.
State of Minnesota Department of Highways	1. It should be noted that although maintenance of the portions of the conduit constructed in highway right-of-way will be conducted by the Minnesota Highway Department, costs for such maintenance will be apportioned between appropriate interests and the Minnesota Highway Department in the same manner as the original construction costs.	1. Concur.

Agency Comments on the Bassett Creek, Draft Feasibility Report for Flood Control

Agency	Comments	Response
State of Minnesota Department of Natural Resources	1. The selected plan proposed to reduce the 100-year flood level on Medicine Lake by repairing the existing outlet wier and by modifying the channel downstream of this repaired outlet structure. There are two fisheries' problems which must be addressed with this proposed action. First, reduction in spring high-water levels of a fraction of a foot will reduce the amount of shoreline marsh areas available for northern pike spawning. To offset this loss, a minimum of 20 acres of controlled northern pike spawning area, acceptable to DNR, will have to be established in Plymouth Creek or another *suitable location in Medicine Lake's* immediate watershed. 2. The removal of natural obstructions (stumps, brush, logs, rock, vegetation and its by-products) in and along the stream will significantly alter or destroy fish and wildlife habitat. The use of interpretation of the adjective "excessive" used to describe this debris is questioned. What criteria will be used to determine the amount of *this* "natural debris" *to* be removed from Bassett Creek? Removal of trees with partially exposed root systems and snags will eliminate habitat for fishes and other aquatic organisms. The need for removal of "stands of extremely dense brush" is also questioned. The species and numbers of fish and wildlife inhabiting the stream sections to be snagged and cleared should also be determined. 3. An additional responsibility of the local sponsor is to acquire all the necessary permits from the State of Minnesota. 4. The total value of tangible flood losses will increase in the future, as stated, but not for all of the reasons given. It should be noted that future urban renewal programs and continued residential, industrial and commercial development in the floodplain are subject to floodplain regulations which requires flood protection to the 100-year flood level. Furthermore, future improvements and structural replacements are also permitted under floodplain regulations which require them to be protected against flooding. Therefore, new development in the floodplain and structural alterations and replacements of existing structures *would have a minimal contribution to future flood* losses. 5. The following sentence is ambiguous: "Channels would be designed for easy maintenance, stable side slopes and adequate freeboard." What specifically is adequate freeboard? 6. It is stated that the proposed floodwall on the left bank of the *channel downstream of Glenwood* Avenue would not be built to the Standard Project Flood elevation because a flow split would occur upstream of the floodwall. We request additional information pertaining to this. With the proposed project at what elevation would this flow split occur? Would the flow split occur at an elevation below the Standard Project Flood and above the elevation of the proposed floodwall? Our primary concern is: would the floodwall be overtopped before the channel split occurs upstream?	1. Further coordination with representatives of the Fish and Wildlife Service and the Department of Natural Resources has resulted in a revision of the proposed outlet for Medicine Lake, so that normal high spring water levels will not be affected. Flood levels resulting from runoff events of a magnitude less than a 20-year frequency would not be lowered. 2. The proposed plan has been revised to eliminate clearing and snagging in Golden Valley. Clearing and snagging will be conducted from the conduit entrance to Cedar Lake Road where failing retaining walls and considerable man-made debris impair the hydraulic efficiency of the channel. 3. Comment acknowledged. 4. Report revised to reflect comment. 5. An allowance for freeboard above the computed water surface elevation in a channel is generally provided so that during a design storm the channel will not overflow due to *possible variations in hydrology*, embankment settlement, superelevation of flow at curves, formation of waves, or ther unexpected hydraulic performance. The amount of freeboard allowed will vary depending on the type of construction, size of channel, consequences of overflow, velocity of flow and possible effect of debris accumulation at crossings. Each situation must, therefore, be evaluated separately to determine the freeboard requirement. 6. A flow split will occur at a flood level of approximately elevation 822 upstream of Glenwood Avenue approximately 4 feet below the elevation of the Standard Project Flood. As illustrated on the flood profile, plate H-15, there is a substantial head loss at the Glenwood Avenue crossing with large flood flows and a significant change in the flood profile downstream of Glenwood Avenue. Because of the head loss at Glenwood Avenue, the flow split would occur before the floodwall is overtopped.
Minnesota Pollution Control Agency	1. The MPCA recognizes the primary purpose of the project is to control flooding on Bassett Creek. In addition, storm water drainage from the proposed I-94 freeway will be an integral part of the preferred alternative. There is concern that the project in its entirety is not considered in one EIS. We recognize the logical break in the Highway EIS and Corps EIS takes place where flood control meets the highway drainage point. Both responsibility of construction and economics change at this point. We do, however, feel that the *total impact of the flood control project* should be assessed in addition to the highway drainage to include effects on the Mississippi River, groundwater, etc. from the combined project. 2. It would be important to discuss the water quality to include the location and extent of storm sewage and an inventory of point source discharges including the characteristics of the discharges. Second, the effects on water quality from clearing, snagging and sediment removal cannot be assessed until information is made available on whether the bottom and stream bank sediments are polluted. Third, the effects on increased future urban runoff should be discussed. Finally, there should be an assessment and a statement on what, if any, water quality standards will be violated by the action. 3. The Agency is concerned over the general deterioration of certain groundwater supplies in the area. It is necessary to include in the EIS, a discussion on the effect on groundwater. The watershed, during most of the year, is a discharge area for groundwater, but during the dry periods, the area would temporarily be recharging. Some discussion is necessary on *how and when* this occurs in conjunction with the environmental effects that might result from the project. 4. The effect on this project on hydraulics of the watershed is presently unclear. What effect will the project have on stream velocities and low flow? Will the project affect the assimilative capacity or the natural purification capabilities of the streams involved? Will the lakes have reduced or increased flushing rates? These questions are important to the overall assessment of impacts.	1. The Minnesota Highway Department is currently conducting an analysis of the environmental impacts of their highway drainage project. 2. An inventory of point and nonpoint discharges and an analysis of the effects of runoff from future development is beyond the scope of this study, however, the Bassett Creek Flood Control Commission has initiated an intensive stream monitoring program to identify reaches of the stream where water quality is being affected *by point and nonpoint discharges. When these* reaches have been isolated, the Commission intends to investigate methods of eliminating or reducing the effects of point and nonpoint sources on water quality in those reaches. The Bassett Creek Flood Control Commission is also conducting studies of the effect of increase urban runoff on the water quality of the creek, lakes and ponds in the watershed and is evaluating alternate methods of minimizing the effects of increased urban runoff on water quality. During advanced planning studies, bottom and stream bank sediments will be sampled to determine if they are polluted. Water quality standards would not be violated by the proposed action. 3. During construction, groundwater levels would be reduced in the immediate vicinity of construction areas because of dewatering, however, they would return to normal soon after construction. During flood periods, groundwater levels would be slightly higher than normal in the vicinity of flood storage areas for several additional days. The existing recharge to aquifers during dry periods would not be affected by the project. 4. Flood flow velocities downstream of the proposed control structures will be reduced, however, low flow discharges will not be affected. The existing assimilative capacity and existing natural purification capabilities of the stream will not be reduced and the flushing rates of the lakes in the watershed will not be affected.

Agency Comments on the Bassett Creek, Draft Feasibility Report for Flood Control

Agency	Comments	Response
Hennepin County Department of Public Works	1. Since there are structures adjacent to Douglas Drive (C.S.A.H. 102), we believe the proposed grade raise would have to be studied in more detail to determine the feasibility of this action. 2. County Ditches No. 25 and 30 make up that portion of Bassett Creek between Medicine Lake and 0.5 mile east of Winnetka Avenue. Any proposed work with the county ditch portion of Bassett Creek would require adherence to Minnesota Statutes as they relate to county ditches. This requires publication of notice and holding of Public Hearings before the County Commissioners prior to any work being done.	1. Concur 2. Concur
General Mills, Inc.	1. Because of the substantial value of properties owned by General Mills which are at or below the 890-foot flood plain level, it is imperative to General Mills that such properties or as much thereof as possible be released from flood plain restrictions and limitations imposed by the ordinance so as to allow development and to maintain a reasonable market value of the same. 2. The plan as proposed and recommended indicates that adoption and implementation of the plan will remove substantially all of General Mills' acreage from flood plain controls. This implication is not clearly borne out in the report which does not set forth information regarding the flowage volumes anticipated, total storage capacity required of flood water retention areas or reservoirs and the capacities of these reservoir areas. 3. Cost estimates regarding alternative plans must include the values by reason of the same being contained in the proposed reservoir areas and otherwise located below flood plain levels. 4. The extent of barriers which would be required to protect private property from inundation at the proposed flood levels appears to be substantial, requiring the purchase of private lands for construction of the same. The cost of taking these lands and construction of such barriers must be considered in examining the feasibility of the proposed plan. In addition, the construction of barriers may be difficult by reason of possible effect of the same upon protected "wetlands" areas. (See 40 Fed. Reg. No. 144 dated July 25, 1975.) Conflicting legislation of this nature must be considered in evaluating any flood control plan. 4. The redevelopment program if implemented, could coincide with a Bassett Creek flood control plan whereby an open channel might be constructed to permit unrestricted flowage of water through the Minneapolis area which would, in turn, substantially reduce the necessity for upriver flood control measures such as those proposed in the plan submitted.	1. Neither the policies of the Bassett Creek Flood Control Commission nor the provisions of the Golden Valley Flood Plain Ordinance completely restrict development below the current flood zone elevation of 890. The Commission's policy allows filling of the flood plain with compensating flood storage and/or channel improvement so that the flood level will not be increased at any point along the channel. Golden Valley's Flood Ordinance allows filling to the extent that reasonable anticipated uses will not unduly affect the efficiency of the flood plain or unduly increase flood levels assuming an equal degree of encroachment for a significant reach of either side of the stream. Any use which increases the flood level by more than 0.5 foot per reach or the cumulative effect of several reaches or increased flood damage is deemed to unduly decrease the capacity of the channel or flood plain. The proposed plan would lower the 100-year flood plain elevation to 889 as shown on the profile H-17 of the report. It is expected that current flood plain regulations would be amended to reflect proposed project conditions and the above-mentioned policies would then apply to the flood plain below elevation 889. 2. The existing 100-year flood plain elevation of the area in question is approximately elevation 888 as shown on plate H-17. The existing 100-year flood discharge at Winnetka Avenue is 830 cubic feet per second as listed in Table 4, page H-17 of the report. To reduce flood damage in the reach of Bassett Creek from Winnetka Avenue to Highway 100 in Golden Valley, it is proposed that the 100-year flood discharge at Winnetka Avenue be reduced to 400 cubic feet per second as listed in Table 4, page H-17 of the report. To reduce the discharge at Winnetka Avenue from 830 cfs to 400 cfs, 500 acre-feet of flood storage volume must be provided upstream of Winnetka Avenue. Assuming that private properties between Brookview Community Park and County Road 17 were completely filled and developed providing no flood storage on private properties then the 100-year flood level would be approximately elevation 889 or 1 foot above the existing flood level of approximately elevation 888 as mentioned in the report on page F-33. The control structure at Winnetka Avenue would have a 25-foot long overflow weir with crest at elevation 885 and a low-flow culvert with invert at elevation 879. With a standard project flood, the structure at Winnetka Avenue would be inundated and the water surface profile would approach normal or existing conditions. The estimated elevation of the standard project flood in the area of General Mills is 890. 3. If the proposed project were implemented, it is expected that the existing flood zone elevation contained in Golden Valley's Flood Plain Regulations would be amended to approximately elevation 889 depending upon the outcome of later, more detailed studies. The amended ordinance would continue to allow the development of the flood plain (areas below elevation 889) to the extent that its anticipated use would not unduly affect the efficiency of the flood plain. Because of the necessary flood storage volume (500 acre-feet) can be obtained on existing public properties and because private properties could be developed consistent with the ordinance, it is not expected that property values would change appreciably from existing conditions. 4. Consistent with the city of Golden Valley's existing Flood Plain Regulations, encroachment into the flood plain (below elevation 890) are allowable if they do not unduly affect the capacity of the flood plain. Development of these "flood fringe" areas requires that all damageable property be elevated or flood proofed to the regulatory flood protection elevation. It is expected that elevating structures on fill or flood proofing structures which would be located below the flood protection elevation would be more economically feasible than flood barriers as a means of flood protection. Nondamageable property such as lawns, recreation areas, and parking areas are acceptable uses of the flood plain and do not required flood protection.

Agency	Comment	Response
		Since Bassett Creek is not as yet subject to the provisions of Section 404 of the Federal Water Pollution Control Act Amendments of 1972, it would be premature to assess the possible impacts of this legislation of the proposed flood control plan. The proper time for the assessment, if necessary, would be during the post-authorization study phase when the Section 404 will have been in effect and more data are available.
		5. It an open channel were constructed to replace the existing conduit, it would not affect the *amount of storage required in upstream communities* to prevent damage in those reaches unless all of the existing restrictive channel crossings were enlarged and the channel modified to permit unrestricted flow of the 100-year flood discharge. At the present time, there are 26 restrictive channel crossings on the main stem of Bassett Creek between the existing conduit entrance and the Brookview Community Park. In order to permit unrestricted flow of the 100-year flood discharge, all of these crossings would have to be replaced with bridges and the channel between the conduit entrance and Brookview Community Park would have to be enlarged substantially. Because channel modifications and realignments are socially unacceptable to residents of the watershed, as discussed in the report (page C-11), and because the extensive modification of the channel and crossings would be economically infeasible, a plan to provide unrestricted flow for the 100-year flood was eliminated as a possible alternative early in the planning *process*.
Wallace E. Freeman	1. The present 100-year flood level in the area where Mr. Freeman owns property is between 887 and 888 feet and it is on the 888 foot elevation that Mr. Freeman, for several years, has based his plans for developing his property. On May 15, 1972, the City of Plymouth zoned this property for commercial and multiple residential property and approved Mr. Freeman's development plans which were based on a 100-year flood level of 888 feet. The selected plan, as set out in the Draft Report, as we understand it, would increase the 100-year flood level over Mr. Freeman's property by at least one foot to 889 feet. If storage for flood waters to a level of 889 feet is necessary over Mr. Freeman's property, we estimate that approximately 20 acres of commercial and multiple residential property would be affectively removed from development.... 2. If our understanding, as obtained through such study and the October 9th meeting is correct, then the impact on Mr. Freeman's property is minimal with one exception. That is, that even if no portion of *Mr. Freeman's property is required for flood water* storage purposes, it will be necessary for Mr. Freeman, at the very least, to fill portions of his land to an elevation of 890 feet in order to develop it in accordance with his development plans formerly submitted to the City of Plymouth. Such cost of flood proofing is not included in the Draft Statement. We respectfully submit that this cost should be recognized in the Final Environmental Impact Statement and Mr. Freeman should be compensated accordingly.	1. Development of the property in question is, at the present time, subject to the policies of the Bassett Creek Flood Control Commission. In accordance with the "Watershed Management Plan for Bassett Creek", adopted by the Commission in 1972, land use of a type which would be damaged by flood waters is not permitted below elevation 890 in this area. Allowable types of land use below elevation 890 would include parking areas, storage areas, recreation areas, and open space if they do not increase flooding. The Management Plan allows filling of areas below elevation 890 for development if compensating flood storage or increased channel capacity can be provided. It is proposed to reduce the 100-year flood discharge at Winnetka from 830 cubic feet per second to 400 cubic feet per second as listed in Table 4, page H-17 of the report. To reduce the discharge to 100 cubic feet per second, 500 acre-feet of flood storage must be provided upstream of Winnetka Avenue. It was assumed that private properties upstream of Winnetka Avenue would be filled and developed consistent with existing land use plans and, therefore, the resulting proposed flood level was determined to be elevation 889. 2. Existing policies of the Bassett Creek Flood Control Commission would require damageable *property* to be located above elevation 890 in this area. Therefore, portions of the property would have to be filled to approximately elevation 891 with existing conditons. With proposed conditions, damageable property would have to be located above elevation 889 which would require portions of the property to be filled to approximately elevation 890. The cost of flood proofing the property would, therefore, be less with proposed conditions than the cost of flood proofing with existing conditions.

A notice of the late stage public meeting was prepared and distributed to interested Federal, State and local interests in September 1975. The notice contained a brief dicussion of the problem, alternative solutions considered and a description of the tentatively selected plan. Approximately 4,500 copies of the notice were distributed and in addition, local news media publicized the meeting. The late stage public meeting was held jointly by the St. Paul District, Corps of Engineers and the Bassett Creek Flood Control Commission in Robbinsdale, Minnesota, on 15 October 1975 and was attended by approximately 350 people. The proposed plan of improvement was presented and questions concerning the plan were discussed. Several local officials and interested individuals expressed support for the plan. Several individuals were opposed to certain features of the plan and requested that final designs be coordinated closely among the various interests. A resoltuion expressing the willingness of the city of Minneapolis to provide the required local cooperation is attached to this appendix. Resolutions adopted by the Cities of Golden Valley, Crystal, Plymouth, St. Louis Park, Robbinsdale and Minnetonka supporting the plan are also attached.

SUMMARY

The extensive coordination and public involvement program involved in this study was an invaluable asset in identifying the problems and needs of the watershed and in evaluating alternative solutions. The effort expended and concern expressed by interested citizens and advisory committees are appreciated and are to be commended.

COMMENTS RECEIVED ON

PHASE II FEASIBILITY REPORT

United States Department of the Interior

NATIONAL PARK SERVICE
MIDWEST REGION
1709 JACKSON STREET
OMAHA, NEBRASKA 68102

IN REPLY REFER TO:
L7423 MWR CL

SEP 2 (1975

Colonel Max W. Noah
District Engineer
St. Paul District, Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Reference is made to your letter of September 9, 1975, pertaining to the feasibility study for flood control in the Bassett Creek watershed, Hennepin County, Minnesota.

Our Midwest Archeological Center concurs with the Minnesota Historical Society's comment that an archeological survey of the project area is needed. In addition to providing useful data for proper resource management, such a survey would be a major step in meeting Corps obligations under Executive Order 11593 and the Historic Preservation Act of 1966.

We recommend continued cooperation with the Minnesota Historical Society as an effective means of assuring adequate protection for cultural resources. In addition, close attention to the Advisory Council on Historic Preservation's "Procedures for the Protection of Historical and Cultural Properties" (36 CFR, Part 800) will insure timely action during project planning.

Sincerely yours,

Robert L. Giles

for Merrill D. Beal
Regional Director

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
ES-FWP

Colonel Max W. Noah
District Engineer
U. S. Army Engineer District
St. Paul
1210 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

OCT 9 1975

Dear Colonel Noah:

This responds to your letter of September 9, 1975, requesting our review of the draft Feasibility Report and draft Environmental Impact Statement for the proposed Flood Control Project on Bassett Creek, Hennepin County, Minnesota. Our comments are submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the National Environmental Policy Act of 1969. They are provided for technical purposes only, and do not necessarily represent the views of this Service and the Department of the Interior in respect to a review of the final documents.

DRAFT FEASIBILITY REPORT

The plan tentatively selected as best meeting the flood control needs of the watershed contains a combination of structural and non-structural features. The principal flood control features include the construction of a new conduit in the right-of-way of the proposed Third Avenue highway distributor; increased temporary floodwater storage in several golf courses, parks, and wetland areas; selected channel clearing and debris removal; relocation of two homes and flood proofing of nine others; modification of the outlet of Medicine Lake and immediate downstream channel; continuation of flood plain regulations and insurance programs; and development of a recreational bicycle and walking path.

In general, the plan tentatively recommended in the report appears to adequately resolve the flood control problem with minimal adverse environmental impact. There are several desirable features in the tentative plan that would directly benefit fish and wildlife populations. The 20-acre, Type IV and/or Type V wetland "ponding" area created at the inlet to the proposed conduit would provide valuable habitat for "urban" waterfowl, particularly the expanding Canada goose population. The relocation of several homes is a positive approach to solving long-term flood plain problems. Perhaps several of the nine homes to be flood proofed also could be relocated. With a benefit/cost ratio of 1.9, some additional costs resulting from home relocation may be acceptable.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

The use of parks and golf courses as temporary floodwater storage areas are acceptable and appropriate functions of a flood plain.

We are pleased that the citizens of the area, through several public meetings, have indicated that channel modifications and realignments are unacceptable and, wherever possible, the creek should be left in its existing state. We support this view.

The Twin Cities Metropolitan Council and the City of Minneapolis have expressed interest in an open space proposal calling for the development of a Bassett Creek Parkway. Consideration of this proposal may depend upon the results of the Open Conduit Feasibility Study being conducted by the City of Minneapolis. The total development of a parkway and open conduit would protect and enhance the natural environment of the creek, including fish and wildlife resources. As such, we urge you not to make a final decision on the recommended plan until after this study has been completed and reviewed.

The feasibility report indicates that the water quality of Wirth Lake has deteriorated significantly and that the process of eutrophication is accelerating. Water quality testing on the stream should continue in an effort to locate and abate water pollution sources. Alternatives, such as "no action" or channelization would further degrade the lake's water quality, and would be unacceptable to us. Efforts should be made to improve the aesthetic and fish and wildlife values of the lake.

Page 17 of the report indicates that, in general, recreational facilities available to the general public in Hennepin County are adequate to meet existing needs. On November 26, 1974, the Metro Council conducted a public hearing on its proposed Recreation Open Space Development Guide/ Policy Plan. Mayor Hofstede of Minneapolis indicated that quality of existing open space is deteriorating as a result of increased human use and demand. Mayor Hofstede also recommended the addition of the Bassett Creek Parkway to the open space proposal. The net impact of acquiring and developing Bassett Creek as a parkway generally will benefit fish and wildlife resources by permitting the preservation and rehabilitation of the natural environment. The future recreational needs of the area should be investigated further and discussed in the report.

Also the report on page 15-17 does not indicate clearly the diversity of wildlife species present in the study area. Actually, 282 species of birds, 96 species of fish, 57 species of mammals, and 33 species of amphibians and reptiles occur in the seven-county Metropolitan area. Certainly a major portion of this variety can be found in the Bassett Creek Watershed as evidenced by the diversity of habitat present.

The outlet of the 915-acre Medicine Lake will be repaired; and 500 feet of channel immediately downstream from the outlet will be deepened to reduce the 100-year flood level of Medicine Lake by 0.5 feet as indicated on page 78 and 79. Such a reduction in the 100-year flood level would help prevent flood damage now occurring around the lake. Unfortunately, the lowering of the lake during the spring flood period also would result in the loss of natural northern pike spawning areas present along the edge of the lake. Two major northern pike spawning areas occur on the lake on the north end and on the southwest end of the lake. According to the Minnesota Department of Natural Resources (DNR), the lake is at near optimum northern pike production condition and is currently providing excellent fishing-use opportunities.

Since the proposed project on Medicine Lake would have an adverse impact on fisheries, compensatory action is required to protect existing environmental quality, economic, and social well-being benefits.

The loss of the valuable northern pike spawning areas in particular would be a project responsibility. We recommend that a controlled northern pike spawning area in combination with a carp barrier be constructed on the lower 1 mile of Plymouth Creek, upstream from Medicine Lake, to compensate for the loss of northern pike spawning areas on the Lake due to the proposed lowering of the 100-year flood level. These developments should be closely coordinated with the Minnesota Department of Natural Resources.

The proposed underground conduit outlet to the Mississippi should be designed as a fish barrier to prevent movement of fish upstream from the Mississippi River. At high stream flow conditions, velocities in the long conduit will stop upstream migration, but at low flows a 3-4-foot vertical drop will be needed somewhere in the conduit. A barrier in the conduit also will provide for application of selective carp toxicant to the watershed.

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Our comments regarding the Feasibility Report also apply to the draft statement.

In general, the Environmental Impact Statement provides a list of reasonable and environmentally acceptable alternatives to the problem of flood control on Bassett Creek. A balance of structural and non-structural flood control alternatives is apparent in the proposed plan.

The description of fish and wildlife resources is inadequate somewhat and should be expanded. No mention is made of the project's effect on the fisheries and associated recreational-use opportunities of Medicine Lake. As indicated in the Feasibility Report, the lowering of the 100-year flood level of Medicine Lake by 0.5 feet would have detrimental

effects on the northern pike spawning areas. This action should be thoroughly discussed under Environmental Impact of the Proposed Action. In our review of the Feasibility Report, specific recommendations regarding this matter were made. The proposed project should be modified to include these recommendations due to the high value of the existing fishery in Medicine Lake. Close coordination should occur with the Minnesota Department of Natural Resources.

We look forward to continued coordination in seeking acceptable flood damage alternatives in the Bassett Creek Watershed.

Sincerely yours,

Acting Regional Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
LWR

FEB 17 1976

Colonel Forrest T. Gay
District Engineer
U.S. Army Engineer District
St. Paul
1135 U.S. Post Office and Custom
House
St. Paul, Minnesota 55101

Dear Colonel Gay:

This letter supplements our views of October 9, 1975, regarding the draft Feasibility Report and draft Environmental Impact Statement for the proposed Flood Control Project on Bassett Creek, Hennepin County, Minnesota. These comments are provided for technical purposes only and do not necessarily represent the views of this Service and the Department of the Interior in respect to a review of forthcoming final documents.

Our October 9, 1975 letter expresses concern regarding the proposed modification of the outlet of Medicine Lake and its subsequent effect on an existing high quality northern pike fishery. The originally proposed modification would reduce the 100-year flood level of Medicine Lake by 0.5 feet or more. Such a reduction in the 100-year flood level would help prevent flood damage now occurring around the lake. Unfortunately, the lowering of the lake during the spring flood period also would result in the loss of natural northern pike spawning areas present along the north end and southwest end of the lake. According to the Minnesota Department of Natural Resources (DNR), the lake is at near optimum condition for northern pike production and currently provides excellent fishing.

We recommended in October that a controlled northern pike spawning area in combination with a carp barrier be constructed on the lower 1 mile of Plymouth Creek, upstream from Medicine Lake, to compensate for the loss of northern pike spawning areas on the lake due to the proposed lowering of the 100-year flood level.

Since then, we have met with your staff, the Bassett Creek Flood Control Commission and the Minnesota Department of Natural Resources to resolve this matter. Revised and more accurate stage frequency curves for Medicine Lake were reviewed. As a result, a new proposal to modify the outlet of Medicine Lake was agreed upon which would not

affect the current spring high water levels below the 20-year flood frequency. This would insure adequate water conditions for most years over the existing northern pike spawning areas.

If the location and design of the outlet of Medicine Lake accommodate these mutually agreed upon flood stage frequency conditons, the existing northern pike spawning areas can be adequately protected, while also reducing flood water damage resulting from the occasional 100-year flood. This modification would satisfy adequately our concerns regarding the Medicine Lake northern pike fishery. These developments should be coordinated with the Minnesota Department of Natural Resources.

We look forward to continued coordination in seeking acceptable flood damage alternatives in the Bassett Creek Watershed.

Sincerely yours,

Assistant Regional Director
Environment

cc: Minnesota DNR, St. Paul

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
MINNEAPOLIS AREA OFFICE
831 SECOND AVENUE SOUTH
MINNEAPOLIS, MINNESOTA 55402

IN REPLY REFER TO:
Land Operations
(ER 75/926)

OCT 10 1975

Colonel Max W. Noah, District Engineer
Department of the Army
St. Paul District, Corps of Engineers
1135 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Re: Review of Draft Environmental Impact Statement and Feasibility Report for Flood Control, Bassett Creek Watershed, Hennepin County, Minnesota (ER 75/926).

We have completed our review of the above referenced environmental impact statement and feasibility report. The report is well-organized and comprehensive in relation to the overall resources management planning.

There are no known Indian Trust lands or interests in the project area; therefore, we do not anticipate any adverse effects from the proposed project.

Thank you for the opportunity to review the statement and report.

Sincerely,

Acting Area Director

United States Department of the Interior
BUREAU OF MINES
BUILDING 20, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

Office of
Chief

Intermountain Field Operations Center

October 14, 1975

Colonel Max W. Noah
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Customs House
St. Paul, Minnesota 55101

Dear Colonel Noah:

Personnel of the Intermountain Field Operations Center have reviewed the Corps' draft environmental impact statement and feasibility report for flood control on Bassett Creek watershed, Hennepin County, Minn. (ER-75/926), as requested by Bruce Blanchard, Director, Office of Environmental Project Review, U.S. Department of the Interior, on September 23.

In general the documents are clear, concise, well written, and well organized. The technique of utilizing a three-document framework, in which supporting data, environmental aspects, and feasibility studies are presented separately, is particularly refreshing and appropriate. Such an approach avoids redundancy in the individual documents and expedites our review process.

In view of the scope and location of project measures, we anticipate that the project will have no adverse impact on mineral resources and related industries in the watershed, and we have no objection to the project or the documentation.

One of the major facets of the Corps watershed studies conducted for the project area concerns the interrelationship between advance planning and the potential for increased runoff that will result from anticipated urbanization of the watershed. The hydrologic study (section H-appendix 1)

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

acknowledged that the watershed is rapidly urbanizing, that progressively larger discharges are expected as urbanization increases, and that runoff-urbanization models have been compiled for the watershed. Such modeling studies provide a valuable data base for wise and judicious flood plain management planning, and although development of flood plain regulations is the responsibility of local governments, we suggest that the Corps attempt to prevail upon them to utilize such information.

Sincerely yours,

Raymond L. Lowrie

cc: Special Assistant to the Secretary, North
Central Region, Chicago, Ill.

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

October 15, 1975

Colonel Max W. Noah
District Engineer - St. Paul District
Corps of Engineers
U. S. Department of the Army
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

The preliminary draft feasibility report for flood control "Bassett Creek Watershed, Hennepin County, Minnesota," which accompanied your letter of September 9, 1975, has been received by the Department of Commerce for review and comment.

The report has been reviewed and the following comments are offered for your consideration.

Although flood forecasting-flood warning services were mentioned under "other alternatives" no description was included regarding the extent of the services. Since a flood warning service is a non-structural alternative, it is considered an oversight not to include the type of services as shown on the enclosure that are available from the National Weather Service, Weather Service Forecast Office, in Minneapolis which also has a long-range weather radar.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE CENTRAL REGION
Room 1836
601 East 12th Street
Kansas City, Missouri 64106

October 17, 1975

WFC2x2

District Engineer
Corps of Engineers
1135 U. S. Post Office
and Custom House
St. Paul, MN 55101

Subject: Preliminary Draft Feasibility Report - Bassett Creek Watershed, Hennepin County, Minnesota

Reference: NCSED-PB, September 9, 1975

Dear Sir:

Reference is made to your letter which transmitted a copy of the Feasibility Report for Flood Control for the Bassett Creek Watershed in Hennepin County, Minnesota, and your questionnaire (attached). Flood forecasting and warning services are a non-structural alternative to minimize flood damage. Hence, the following is submitted for your use:

The National Oceanic and Atmospheric Administration (NOAA) National Weather Service provides no specific flood stage forecasts for the Bassett Creek Watershed, Minnesota. The technology of accurate river and flood forecasting is dependent upon adequate and timely rainfall and river stage reports, and it is even more essential that such basic data be available, particularly rainfall reports for flood-prone areas. The Bassett Creek Watershed is in the Minneapolis River District. Current funding restraints prevent National Weather Service operation of the relatively dense networks required for specific stage forecasts for the multitude of small streams. However, this problem has been resolved as follows:

Hennepin County, Minnesota, is in the service area of the Minneapolis NWS Office. In addition to the routine two-a-day weather forecasts, special forecasts of severe storms and general flash flood warnings for small streams in the county are issued as required by meteorological events. Hennepin County is within the range of the radar at Minneapolis which is capable of detecting the area and movement of intense precipitation. Radar observations of intense rainfall and projection of storm movement give some lead time for flash flood warnings, which are promptly disseminated to all news media and local officials by the best communications available, including telephone.

We have no other comments. The other parts of the report appear to be satisfactory. If you have need for further information, please telephone me at 816-374-3229.

Sincerely,

Lawrence Langbein for.

Elroy C. Balke
Regional Hydrologist

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

ER-75/926

OCT 24 1975

District Engineer
U. S. Army Corps of Engineers
1135 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Sir:

We have reviewed your draft environmental impact statement and feasibility report on flood control in the Bassett Creek watershed and offer the following suggestions.

The presentation of the plan and its alternatives could be enhanced by including in the environmental statement flood outline maps for the existing condition, the proposed plan, and the environmentally more desirable alternative. Two such maps are provided in section H of the appendix to the feasibility report (H-25 and 26) but they would be particularly appropriate for the consideration of alternatives.

The costs of the non-structural alternatives 2 and 3 (DES, p. 42-43), and the open channel alternative 6-E (DES, p. 48) are only given as totals. Since these figures are so much higher than those for other plans, a partial breakdown of costs to put them into better perspective would be desirable.

The hydrologic and hydraulic analysis of the plan (section H, appendix to feasibility report) appears to be soundly derived.

The environmental statement does not evaluate impacts of the various phases of the proposed project on water-table conditions in the glacial drift (FR, appendix 1, p. B-7 and plates H-1, H-2), nor on artesian heads in the sandstone and dolomite aquifers. Effects of the tunneling and channelization on ground-water hydraulics, storage, water levels and possibly local underflow in the artesian aquifers should be considered.

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The final statement should present more quantitative information on both the unconsolidated water-table aquifer and any affected artesian aquifer (especially typical permeabilities, storage coefficients, and normal water levels) and should evaluate both beneficial and adverse impacts.

Thank you for the opportunity to comment on the environmental statement and feasibility report.

Sincerely yours,

Henry W. Coulter

Acting Director

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 5
Suite 490, Metro Square Building
St. Paul, Minnesota 55101

October 30, 1975

IN REPLY REFER TO:

Colonel Max W. Noah
District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

As requested, the draft of your feasibility report for flood control in the Bassett Creek watershed, Hennepin County, Minnesota has been reviewed. We have no substantive comments to offer.

Federal Highway Administration comments regarding your draft environmental statement (EIS) were offered separately, by our Regional Administrator's letter of October 14, 1975.

We would appreciate copies of your final feasibility report and EIS for future reference relative to highway drainage plans for I-94 and I-394.

Sincerely yours,

E Dean Carlson

E. Dean Carlson
Division Administrator

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
LAKE CENTRAL REGION
3853 RESEARCH PARK DRIVE
ANN ARBOR, MICHIGAN 48104

IN REPLY REFER TO:
D6423
xG26 MN
NCSED-PB

October 31, 1975

Colonel Max W. Noah
District Engineer
U.S. Army Corps of Engineers,
St. Paul District
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

In response to your request, we have reviewed the preliminary draft feasibility report and draft environmental impact statement for Flood Control, Bassett Creek Watershed, Hennepin County, Minnesota. The following comments are provided to assist you in preparing revised drafts of these documents. Official Department of the Interior comments will be made when the Department is requested to make a formal review.

Feasibility Report

The report should make reference to the Twin Cities Level B Study. Any proposed developments should be coordinated with the final Level B report to assure compatibility with the recommendation of the study.

Several alternatives, including the selected plan, involve flood storage in Jordan Park (Bassett Creek Park) and Brookview Community Park. Portions of these parks have been acquired with monies from the Land and Water Conservation Fund (L&WCF), administered by the Bureau of Outdoor Recreation (Project 27-00600, Jordan Park and Project 27-00267, Brookview Recreation Area). The report should indicate L&WCF involvement in these parks. The feasibility report states that an earthen embankment will be constructed on the eastern boundary of Jordan Park. The dimensions of this embankment (height, number of acres of parkland required) should be indicated. The Existing Land Use Map (Plate B-5) could also be revised to show the present boundaries of Jordan Park. The use of these two parks for flood storage and, in the case of Jordan Park, for an embankment may constitute a change in land use.

Any change in land use within a park funded with Land and Water Conservation Fund creates a 6(f) conflict. Section 6(f) of the Land and Water Conservation Fund Act states that "no property acquired or developed with assistance under this section shall without the Approval of the Secretary of the Interior be converted to other than public outdoor recreation uses. The acceptable means of satisfying such a conversion is the substitution of other recreation lands of at least fair market value and of reasonable equivalent usefulness and location."

We have informed Mr. James T. Solem, Director of the State Office of Local and Urban Affairs in St. Paul, Minnesota, of these potential conflicts. Any plans for these parks should be coordinated with his office. He can be reached by calling 296-2102.

Draft Environmental Statement

The environmental impact statement should make reference to the Twin Cities Level B Study. The possible involvement with Section 6(f) of the Land and Water Conservation Fund Act, relative to Jordan Park and Brookview Recreation Area, should be discussed and the impacts of that involvement included in the section on Impacts on Recreation.

Please feel free to contact this office is you have any questions on the potential 6(f) conflict.

Sincerely yours,

JOHN D. CHERRY
Regional Director

By: Robert J. Blais
Robert J. Blais
Acting

OFFICE OF LOCAL AND URBAN AFFAIRS
MINNESOTA STATE PLANNING AGENCY • CAPITOL SQUARE BUILDING • ST. PAUL, MINNESOTA 55101 • PHONE (612) 221-3091

January 29, 1976

Mr. John D. Cherry
Regional Director
Bureau of Outdoor Recreation
3853 Research Park Drive
Ann Arbor, MI 48104

RE: Possible Section 6(f) Conflicts Occurring on LW27-00600 and LW27-00267

Dear Mr. Cherry:

The question has arisen concerning a possible section 6(f) conflict resulting from a U.S. Army Corps of Engineers flood control project on Bassett Creek. This project has involved two LAWCON fund assisted parks - LW27-00267 and LW27-00600. Portions of both parks have been designated as flood water storage areas while LW27-00600 has also been selected for the placement of a flood control embankment.

Though flooding along Bassett Creek has always been of short duration, the creek flows through a highly developed section of suburban Minneapolis and there is obvious potential for extensive flood damage to homes and businesses near it's banks. Recent flooding has caused a demand from the areas residents that something be done on Bassett Creek to control the flood waters. In response, the Army Corps of Engineers has prepared a draft feasibility report for flood control. This report contains the plans for LW27-00267 and LW27-00600.

After discussing details of the flood control project with Robert Stenfors of the U.S. Army Corps of Engineers; present and future park development with Ed Brandeen, Crystal Park Superintendent; and making personal on-site inspections, I have drawn a few conclusions.

The water storage area on LW27-00267 will require no construction within the park. It will merely be used as an area for excess water to stay during the course of a flood. As the flood waters receed, water will drain off the storage area and gradually Bassett Creek will return to it's banks. The flood storage area will dry out completely and the entire area will be available for normal recreational pursuits. The elapsed time from the beginning of a flood to complete drainage is, at the most, one week. Storage water will not interfere with any development on the site.

The proposed embankment for LW27-00600 will be located in the southeast corner of the park area with the major portion of the embankment not actually within park boundaries. The elevation at the top of the embankment will be approximately at 850 ft. (above sea level). The embankment will allow this area to be used as a flood water storage area while also protecting nearby housing. Again, the flood water will remain less than one week in a year. The embankment will measure approximately 10 feet wide at the top, 40 to 50 feet wide at the bottom, and average about 6 feet high. It will not restrict use in the park in any way and will not be located near any present or future development. (Incidentally, all future development will be placed at an elevation above 850 feet with the exception of a trail on the creek bank). Though, the City of Crystal does not plan to utilize the bank as a trail or path, the potential does exist. The embankment will be completely landscaped, to include grass, trees, and perhaps shrubs or bushes. Aesthetics in the park won't suffer because of it's presence.

In conclusion, it is my opinion that neither utilizing LW27-00267 and LW27-00600 as water storage areas for one week per year nor the construction of the proposed embankment constitutes a section 6(f) conflict as defined in insert 74-5, part 685.2.1 of the Land and Water Conservation Fund Grant Manual. I have also enclosed a map of LW27-00600 illustrating the embankment for your review. Please contact me if you have any further questions.

Sincerely,

Louis Jambois
Project Officer
Parks and Recreation Grants Section

LJ/pkb

Enclosure

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

1 7 1975

Colonel Max W. Noah, District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Noah:

As requested in your letter of September 9, 1975, we have completed our review of the Feasibility Report for Flood Control in the Bassett Creek Watershed in Hennepin County, Minnesota. Our reply concerning the Draft Environmental Impact Statement of August, 1975, will be transmitted under separate cover.

Although the proposed project is primarily concerned with flood control in the watershed, the Feasibility Report is somewhat lacking in the attention it gives to water quality. The report does not inventory industrial and municipal point discharges or non-point sources of pollution within the Bassett Creek Watershed. With continued urban development expected in the watershed, consideration should also be given to the environmental impact of increased urban runoff upon water quality. It is not clear from the report whether or not structural measures will adversely affect the natural purifying capacities of the streams on which they are proposed. These structural measures include those that will significantly alter channel widths, depths, velocities and discharges.

The effect of the selected plan on groundwater quality is not included in the report. In view of the fact that groundwater quality in the watershed is generally deteriorating, the effects of implementing those aspects of the selected plan which would tend to increase groundwater absorbtion should be reported. Additionally, the report should discuss the ramifications, if any, of the proposed project upon the water table in areas of the watershed adjacent to construction sites.

We agree with local citizens and the Feasibility Report that extensive channel modifications within the watershed are undesirable and unnecessary. However, some channel widening and excavation is nevertheless proposed in the selected plan, and, at this stage in planning, the report should address measures which will be taken to minimize and control pollution from construction activities. Since a considerable amount of earth materials will be displaced during excavation and channel widening, it will be imperative to

NOV 17 1975

know whether or not bottom and stream bank sediments are polluted. Excavation of polluted materials could have a serious degrading impact upon water quality, and upon potential disposal sites.

We presume that the 8, 8½, and 10 foot diameter conduits proposed for the section between Irving Avenue North and the Mississippi River will be capable of accommodating the discharge of a 100-year flood. However, the maximum discharge this conduit system can accommodate should be stated within the report.

We appreciate recreational improvements and beautification measures proposed in conjunction with flood protection, and also the attention the report directs toward flood plain regulation. Good flood plain management should definitely be required in conjunction with the proposed project. The model ordinance of the Bassett Creek Flood Control Commission is straightforward and sound in its approach to flood plain regulation. But provision for enforcement of flood plain regulations is less clear, and the attitudes of individual communities and other private interests within the watershed should be discussed. Potential conflicts and unconformities should be addressed in the planning stage. A contradiction appears to exist between proposed flood plain regulations and anticipated future land use in the 100-year flood plain (Appendix 1, B-60). Specifically, Table 25 indicates that residential, commercial and industrial land use is expected to increase sharply within the 100-year flood plain. Such development would have to be viewed as having a degrading impact upon the environment. In summary, the implementation of flood plain regulations needs to be clarified.

The report should be submitted for review to the regional planning agency in the area, the Metropolitan Council of the Twin Cities, in order to ensure conformance with current development plans. In addition, the report should be submitted for review to the City of Minneapolis to make certain that the selected plan is coordinated with the combined sewer separation program now underway in the city. Finally, the report should be submitted for review to the Metropolitan Waste Control Commission to ensure coordination with sanitary sewer infiltration/inflow studies that agency may be sponsoring in communities in the Bassett Creek Watershed.

Thank you for the opportunity to comment on this Feasibility Report.

Sincerely yours,

Francis T. Mayo

Francis T. Mayo
Regional Administrator

1776-1976

STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
ST. PAUL, MINN. 55155

October 31, 1975

Colonel Max W. Noah
District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

In reply refer to: 330
Draft Feasibility Report for Flood Control
for the Bassett Creek Watershed

Dear Colonel Noah:

We have reviewed the above report and have the following comments:

Appendix 1 (Section G Division of Plan Responsibilities)

It is stated in this section that the portions of the project constructed in highway right-of-way will be maintained by the Minnesota Highway Department.

It should be noted that although maintenance of the portions of the project constructed in highway right-of-way will be maintained by the Minnesota Highway Department, costs for such maintenance will be apportioned between the appropriate interests and the Minnesota Highway Department in the same manner as for the original construction as described in this section.

We appreciate the opportunity to review and comment on the draft report.

Sincerely,

Charles E. Burrill

Charles E. Burrill
Assistant Commissioner

AN EQUAL OPPORTUNITY EMPLOYER

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
CENTENNIAL OFFICE BUILDING · ST. PAUL, MINNESOTA · 55155

November 25, 1975

Colonel Max W. Noah, District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, MN 55101

Dear Colonel Noah:

NCSED-ER FEASIBILITY REPORT FOR FLOOD CONTROL AND DRAFT ENVIRONMENTAL IMPACT STATEMENT, BASSETT CREEK WATERSHED

The Department of Natural Resources has reviewed the "Feasibility Report For Flood Control" and "Draft Environmental Impact Statement" for the Bassett Creek Watershed, Hennepin County, Minnesota. This Department generally supports the selected alternative for flood control which includes the following; replacement of the existing 1.5 mile conduit outletting Bassett Creek to the Mississippi River, flood storage, channel works, flood proofing, and the continuation of flood plain regulations and flood insurance in the upper watershed area: provided that the mitigation measures discussed below are included.

The selected plan proposes to reduce the 100-year flood level on Medicine Lake by repairing the existing outlet weir and by modifying the channel downstream of this repaired outlet structure. There are two fisheries' problems which must be addressed with this proposed action.

First, reduction in spring high water levels of a fraction of a foot will reduce the amount of shoreline marsh areas available for northern pike spawning. To offset this loss, a minimum of 20 acres of controlled northern pike spawning area, acceptable to DNR, will have to be established in Plymouth Creek or another suitable location in Medicine Lake's immediate watershed.

Secondly, any alteration to the existing outlet should maintain, or provide, a grate similar to the one at the existing weir. This will prevent adult northern pike from leaving the lake in the spring. The repaired outlet and channel improvement proposed can be expected to create greater fish concentration problems below the dam than now exists. The proposed improvement will create free-fall conditions at the weir which will prevent returning northern pike from entering Medicine Lake.

In conjunction with the construction of the underground conduit, a fish barrier will be constructed to prevent the upstream movement of fish. The Department of Natural Resources supports the inclusion of this feature into the plan which will prevent the migration of rough fish into the watershed. This Department should be consulted for design recommendations when plans are being proposed.

A benefit to wildlife would accrue if another fish barrier were built in the lower one mile of Plymouth Creek just before it enters Medicine Lake. Carp would be eliminated from numerous wetland areas found in the Plymouth Creek Watershed. This barrier would reduce the supply of young carp to Medicine Lake and improve production of native wildlife associated with the wetland environment in the watershed. Northern pike would be provided access to the watershed by means of a temporary operated fishway or by moving them over the barrier. This would be a desireable feature which should be incorporated into the selected plan if at all possible.

The removal of natural obstructions (stumps, brush, logs, rock, vegetation and its by-products) in and along the stream will significantly alter or destroy fish and wildlife habitat. The use and interpretation of the adjective "excessive" used to describe this debris is questioned. What criteria will be used to determine the amount of this "natural debris" to be removed from Bassett Creek? Removal of trees with partially exposed root systems and snags will eliminate habitat for fishes and other aquatic organisms. The need for removal of "stands of extremely dense brush" is also questioned. The species and numbers of fish and wildlife inhabiting the stream sections to be snagged and cleared should also be determined.

In the stream section from Dresden Lane to upstream of T.H. #100, the re-landscaping of the north end of Rice Lake storage area should include plans for the planting and seeding of vegetation which encourages residence and other use of the area by wildlife. Planting should provide food and cover for wildlife. It is best to contact regional staff wildlife expertise in regard to planting recommendations. These recommendations should also apply to the landscaping of all earthen embankments to be constructed in the flood control project. Visual barriers should also be planted with vegetation which encourages wildlife as well as enhancement of the aesthetic qualities of the natural stream setting.

COMMENTS ON DRAFT EIS:

1. Section 1.04

   The last sentence of this section is incorrect and should read as follows:

   "The selected plan has average annual benefits of $1,033,000, average annual costs of 543,000, and a benefit cost ratio of 1.90 to 1."

2. Section 2.44

   This section is only partially correct. The total value of tangible flood loses will increase in the future, as stated, but not for all of the reasons given. It should be noted that future urban renewal programs and continued residential, industrial and commercial development in the flood plain are subject to flood plain regulations which requires flood protection to the 100-year flood level. Furthermore, future improvements and structural replacements are also permitted under flood

plain regulations which require them to be protected against flooding. Therefore, new development in the flood plain and structural alterations and replacements of existing structures would have a minimal contribution to future flood loses.

The first sentence on page 20 should be re-punctuated. As presently written, it could be interpreted two different ways which causes confusion.

3. Section 4.33

This section is only partially correct. It is true that flood plain zoning regulations restrict alterations and extensive repairs to existing non-conforming uses within the regulatory floodway but the overall impacts are not as significant as they have been stated. Normal maintenance and repairs are permitted for all existing flood plain structures and existing structures in the flood fringe could be extensively repaired or altered, if protected to the 100-year flood elevation. Also, existing structures in the flood plain, and future structures in the flood fringe when protected to the 100-year flood elevation, are eligible for federal or federally subsidized financing with the purchase of a flood insurance policy.

4. Section 4.35

This section on flood insurance is inaccurate and is lacking detail. We would suggest this section to be revised considering the following information.

The National Flood Insurance Program is separated into two phases; the emergency phase and the regular phase. Under the emergency phase of the program, insurance premiums are heavily subsidized by the federal government. Coverage for new or existing structures is available up to $35,000 for single unit residential structures ($10,000 for contents) and $100,000 for non-residential structures ($100,000 for contents).

Once a detailed engineering study is completed which establishes the severity of the flooding threat within a community, the community is converted to the regular phase of the program. Rates for new structures are no longer subsidized and are referred to as "Actuarial Rates" and the level of coverage is double that of the emergency program. New structures within the flood plain must be insured at actuarial rates but owners of existing structures may purchase the first phase of the total coverage at subsidized or actuarial rates, whichever are lower.

5. Section 4.45 and 4.49 - "Human Aspects"

Within these two sections, there is reference to evacuation of three homes as well as evacuation of four homes. From these statements, it is difficult to ascertain if the evacuation associated with the project would be three or four homes. These statements should be clarified.

6. Section 4.51 - "Economic Aspects"

The benefit/cost ratio of 1.90, as stated, includes annual recreation and advance replacement benefits which have not been documented in this section. Annual recreation benefits amount to $78,500 and advance replacement benefits are $150,000 annually. Including the $855,000 reduction in annual average flood damages, gives a total annual project benefit of $1,033,500. The total annual project costs are 543,000 and the resultant benefit/cost ratio is 1.90.

"DRAFT FEASIBILITY REPORT FOR FLOOD CONTROL"

1. Pages 96-97 - "Division of Plan Responsibilities"

An additional responsibility of the local sponsor is to acquire all the necessary permits from the State of Minnesota.

2. Page C-4 - "Future Flood Damages"

This statement is basically the statement contained in Section 2.44 of the Draft EIS. It is incorrect and should reflect those corrections referenced earlier in this letter.

3. Page D-2 -

The footnote on the bottom of this page is incorrect.

Minnesota communities are required to adopt and enforce flood plain management regulations within six months after notification by the Commissioner of the Department of Natural Resources that sufficient technical data are available to do so. Also, the current federal requirement for a community to join the National Flood Insurance Program is as follows: a community must join the National Flood Insurance Program by July 1, 1975, or one year after it has officially been designated as flood prone, whichever is later.

4. Pages D-7--D-10 "No Action-Maintain Base Condition"

The status of watershed communities which have adopted flood plain regulations and have joined the National Flood Insurance Program should be updated. As of this date all communities within the watershed have adopted flood plain zoning ordinances except Plymouth and Crystal which are in the process of doing so. Medicine Lake is the only watershed community not enrolled in the flood insurance program and is not presently required to do so by federal or state legislation.

5. Page II-20 - "Hydraulics of Selected Plan"

(a) The following sentence is ambiguous:

"Channels would be designed for easy maintenance, stable side slopes and adequate freeboard." What specifically is adequate freeboard? This should be stated.

(b) Page II-21

It is stated that the proposed floodwall on the leftbank of the channel downstream of Glenwood Avenue would not be built to the standard project flood elevation because a flow split would occur upstream of the floodwall. We request additional information pertaining to this.

With the proposed project, at what elevation would this flow split occur? Would the flow split occur at an elevation below the standard project flood and above the elevation of the proposed floodwall? Our primary concern is: would the floodwall be overtopped before the channel split occurs upstream?

6. Page I-12

The first paragraph on this page should be updated. Minneapolis and Medicine Lake have recently adopted flood plain zoning ordinances.

7. Page I-17

The National Flood Insurance Act should be referenced as the "National Flood Insurance Act of 1968 (PL 90-448) as amended" and not the "National Flood Insurance Act of 1976".

8. Page I-18

The first sentence of the first full paragraph should be changed because New Hope is now presently enrolled in the flood insurance program. Also, the last sentence of the following paragraph should be written as follows:

"After June 30, 1975, or one year after a community's initial notification of being flood prone, no loans will be approved in designated special flood hazard areas unless a flood insurance policy is purchased."

The Department of Natural Resources recognizes the necessity of providing flood protection to the residents and industry located in the Bassett Creek Watershed. We note that the lack of planning on the part of municipalities in the upper portions of the watershed where the problems originate now require that flood protection works be constructed in the lower portion of the Bassett Creek Watershed.

In conclusion, the mitigation which will be required for the loss of northern pike spawning areas within the Medicine Lake area should be coordinated through the DNR Metropolitan Area regional staff. The DNR Metropolitan regional office is located at 1200 Warner Road, St. Paul, MN, (612) 296-7523.

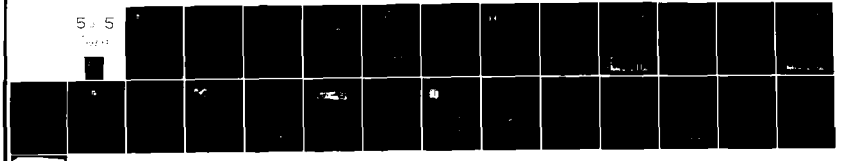
Sincerely,

Gene H. Hollenstein
Acting Director

TL:cnb
cc: PERT members
Division Directors
Regional Administrator, Region 6
Attn: Regional Hydrologist

AD-A119 394 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
BASSETT CREEK WATERSHED, HENNEPIN COUNTY, MINNESOTA, FEASIBILIT--ETC(U)
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Minnesota Pollution Control Agency

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It would be important in the discussion of water quality to include the location and extent of storm sewerage and an inventory of point source discharges including the characteristics of the discharges. Second, the effects on water quality from clearing, snagging and sediment removal cannot be assessed until information is made available on whether the bottom and stream bank sediments are polluted. Third, the effects on increased future urban runoff should be discussed. Finally, there should be an assessment and a statement on what, if any, water quality standards will be violated by the action.

The Agency is concerned over the general deterioration of certain ground water supplies in the area. It is necessary to include in the EIS a discussion on the effect on ground water. The watershed, during most of the year, is a discharge area for ground water but during the dry periods the area would temporarily be recharging. Some discussion is necessary on how and when this occurs in conjunction with the environmental effects that might result from the project.

We understand that the tunnel proposed under the Corps of Engineers flood control project is closed conduit, where a minimum of infiltration and exfiltration would occur. It is, however, not fully disclosed what will take place downstream in the deep tunnel. The effects of draining a ground water table by infiltration or affecting the quality of ground water by exfiltration is unknown and should be discussed.

The effect of this project on hydraulics of the watershed is presently unclear. What effect will the project have on stream velocities and low flow? Will the project affect the assimilative capacity or the natural purification capabilities of the streams involved? Will the lakes have reduced or increased flushing rates? These questions are important to the overall assessment of impacts.

If the previously mentioned impacts are identified, it would then be possible to expound on the mitigating measures that can minimize the impacts.

The Agency suggests that the project include mitigating measures to control non-point source and highway drainage to a greater extent.

The whole success of the flood control project lies in the attitude and enforcement policies of the municipalities on flood plain encroachment. The Agency would support the adoption of strong enforcement policies or regulations to be implemented through the watershed.

In summary, the Minnesota Pollution Control Agency appreciates the opportunity to comment on the Draft EIS and feels confident that if the above mentioned considerations are included in the project formulation process, which includes a strict consideration of the environmental consequences and measures to minimize them, the project will have an overall beneficial impact.

The MPCA's technical staff is available to discuss our concerns in greater detail if necessary. If you have any questions, please feel free to contact me.

Sincerely,

Peter L. Gove
Executive Director

cc: Agency Board
Mr. Russell Peterson, President's Council on Environmental Quality
Mr. Francis T. Mayo, Regional Administrator, U.S. EPA, Chicago
Mr. Robert L. Herbst, Minnesota Department of Natural Resources
Mr. George Hemphill, U.S. Fish and Wildlife Service
Barr Engineering (Leonard Kramer)
Bassett Creek Flood Control Commission
Cities of Crystal, Plymouth, Golden Valley, Minneapolis, New Hope, St. Louis Park, Minnetonka
The Honorable Donald M. Fraser, 1111 Longworth House Office Bldg.
The Honorable Joseph E. Karth, 2408 Rayburn House Office Bldg.
Minnesota Highway Department

Metropolitan Council of the Twin Cities Area

300 Metro Square Building, 7th Street and Robert Street, Saint Paul, Minnesota 55101 Area 612, 227-9421

December 8, 1975

Colonel Max W. Noah
District Engineer
Corps of Engineers
Department of the Army
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

RE: Draft Environmental Impact Statement & Feasibility Report
Flood Control Project, Bassett Creek Watershed, Hennepin County
Metropolitan Council Referral File No. 3046

Dear Colonel Noah:

At its meeting of November 20, 1975, the Metropolitan Council considered the attached report of its Environmental and Transportation Committee on the proposed plan for flood control on Bassett Creek. The Council found the proposed plan in accord with Metropolitan Development Guide policies and plans and directed the forwarding of its report to you as its official comments and recommendations.

Thank you.

Sincerely,

METROPOLITAN COUNCIL

John Boland
Chairman

JB:emp
Attachment
cc: Jim Schoettler, Metropolitan Council Staff

For Release 11.20.75, 4:00 p.m. [illegible]

METROPOLITAN COUNCIL
Suite 300 Metro Square Building, Saint Paul, Minnesota [illegible]

REPORT OF THE ENVIRONMENTAL & TRANSPORTATION COMMITTEE
Referral Report No. 75-[illegible]

TO: Metropolitan Council

SUBJECT: Bassett Creek Flood Control Preliminary Report and EIS Referral No. [illegible]

At its meeting of November 12, 1975, the Committee considered the attached memorandum outlining a proposed plan for flood control on Bassett Creek in Hennepin County.

The Plan essentially consists of flood water storage along the main stem and a new tunnel along the lower 1.5 miles of the creek. The tunnel is to replace an existing tunnel which is in very poor structural condition.

RECOMMENDATION:

That the Council find the proposed plan to be in accord with Metropolitan Development Guide Policies and Plans and forward the attached staff memorandum to the Corps of Engineers as the official comments of the Metropolitan Council.

Respectfully submitted,

Stanley Hayler, Chairman
Gladys Brooks
George Dahlberg
Allen Erickson
Todd Lefko
Marcia Sommer
Jean Campbell
Alton J. Cooper

JS/lm

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minneapolis

city of lakes

OFFICE OF CITY CLERK
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September 24, 1974

Department of the Army
St. Paul Districts Corp of Engineers
1210 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

To whom it may concern:

The Minneapolis City Council at its meeting held on September 12 passed the enclosed certified copy of a resolution. It is our hope that you will read the resolution and that you will be able to take action on it.

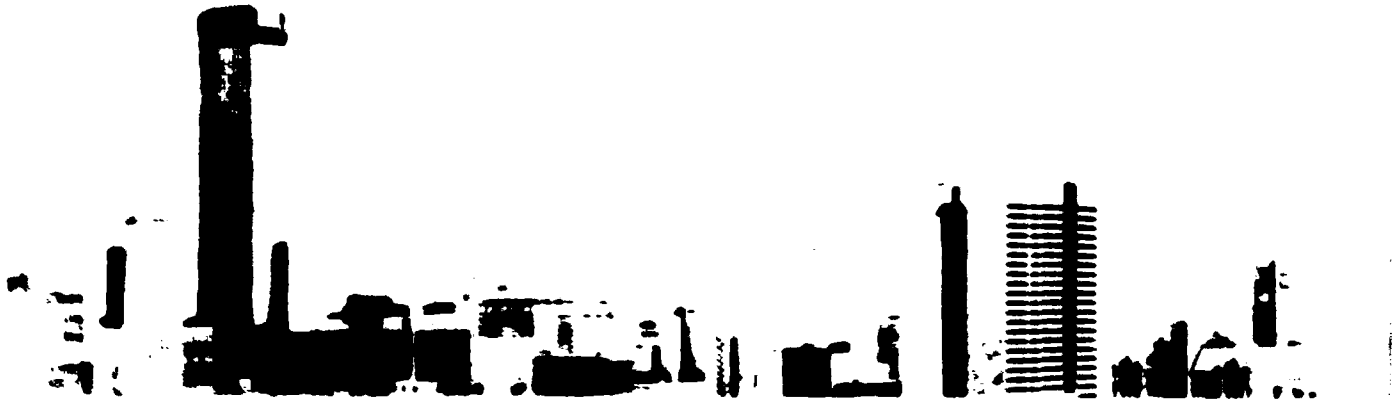
If we can be of service to you, kindly let us know. Thank you for your cooperation.

Sincerely,

Lyall A. Schwarzkopf
City Clerk

Enc.

LAS:el



Form 33 141 6-67

RESOLUTION

(By Alderman Zollie Green)

Expressing the City's intent to cooperate with the Corps of Army Engineers, if a feasible plan to control storm waters within the watershed is developed and is acceptable to the Bassett Creek Flood Control Commission, and setting forth local assurances.

Whereas, the Cities of Minneapolis, St. Louis Park, Crystal, Minnetonka, Robinsdale, Golden Valley, New Hope, Medicine Lake and Plymouth have entered into a joint and cooperative agreement under the authority of *Chapter 471.59, Minnesota Statutes*; and

Whereas, said joint agreement creates a commission to investigate, study, plan and control storm waters within the Bassett Creek Watershed; and

Whereas, the Bassett Creek Flood Control Commission has requested the St. Paul District *Corps of Army Engineers* to aid and assist in preparing a feasible plan to control storm waters within the watershed; and

Whereas, the Corps of Army Engineers has cooperated with the Bassett Creek Flood Control Commission in the preparation of Phase II of their planning and the United States Congress has now approved and appropriated $100,000 to work with the Bassett Creek Flood Control Commission on Phase III; and

Whereas, the Corps of Army Engineers advises the Commission that they would like a resolution of intent from the City of Minneapolis or of some other member municipality to provide local assurances required by Title 33 of the United States code; and

Whereas, the local assurances required by the Corps of Army Engineers would only be required if a feasible and economically acceptable project is developed; and

Whereas, the Bassett Creek Flood Control Commission has requested the City of Minneapolis to express its intention to provide said assurances by adoption of this resolution; and

Whereas, this resolution is merely one of intent to cooperate with the Corps of Army Engineers if a feasible project is developed and is acceptable to the Bassett Creek Flood Control Commission and does not commit the City of Minneapolis to any financial outlay; and

Whereas, the City of Minneapolis has been damaged by floodwaters from Bassett Creek and needs protection against flooding on Bassett Creek; and

STATE OF MINNESOTA,
County of Hennepin, } ss.
CITY OF MINNEAPOLIS,

I, LYALL A. SCHWARZKOPF, City Clerk of Minneapolis, in the County of Hennepin and State of Minnesota, do hereby certify that I have examined the attached copy of a Resolution adopted by the City Council of said city at an adjourned meeting thereof held on the 12th day of September, 19 74, and have carefully compared the same with the original thereof, now on file in this office, and that said attached copy is a true and correct copy of said original, and of the whole thereof.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the corporate seal of said City this 20th day of September A.D., 1974.

City Clerk

Whereas, the majority of the construction required will take place in the City of Minneapolis;

Now, Therefore, Be It Resolved by the City Council of the City of Minneapolis:

1. That the United States Army Corps of Engineers shall be, and hereby is, requested to report on possible local improvements for flood control under the authority contained in a resolution adopted 9 April 1962 by the United States Senate, Committee on Public Works.

2. That the City is aware of the local cooperative requirements in Title 33 of the United States Code and agrees that if a feasible and acceptable project is developed and approved by the Bassett Creek Flood Control Commission and if the Bassett Creek Flood Control Commission is unable to meet the federal requirements, the City of Minneapolis will provide the following items of local cooperation, including, but not necessarily limited to, the following:

a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the proposed project;

b. Hold and save the United States free from damages due to the construction works;

c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

d. Provide without cost to the United States all relocations of buildings and utilities, highway bridges, sewers, related and special facilities, and local betterments;

e. Provide assurances that encroachment on improved channels or on ponding areas will not be permitted; and that, if ponding areas and capacity are impaired, substitute storage capacity will be provided promptly without cost to the United States.

3. That the City of Minneapolis in providing said assurances will require all cities who are members of the Bassett Creek Flood Control Commission to share in any required costs in accordance with the Joint Powers Agreement and the Watershed Management Plan for Bassett Creek as adopted by said Commission on May 18, 1972.

4. That the City Clerk shall be, and hereby is, directed to transmit three certified copies of this Resolution to the District Engineer, Corps of Engineers, United States Army, 1210 U. S. Post Office and Custom House, St. Paul, Minnesota, and one copy to the Bassett Creek Flood Control Commission.

Passed September 12, 1974. Louis G. DeMars, President of the Council.

Approved September 17, 1974. Albert J. Hofstede, Mayor.

Attest: Lyall A. Schwarzkopf, City Clerk.

OFFICE OF CITY CLERK
LYALL A. SCHWARZKOPF, CITY CLERK
311 CITY HALL, MINNEAPOLIS, MINNESOTA 55415
PHONE: 348-2215

minneapolis
city of lakes

November 13, 1975

District Engineer
Corps of Engineers
United States Army
1210 U.S. Post Office & Custom
House
St. Paul, MN 55101

Dear Sir:

The Minneapolis City Council at its October 31, 1975 meeting adopted a resolution commending the Corps of Engineers & Bassett Creek Flood Control Commission for completion of a study for the control of flooding in Bassett Creek Watershed.

The Council favors further steps to implement this plan.

Enclosed are three certified copies of the resolution adopted by the City Council.

Sincerely,

Lyall A. Schwarzkopf
City Clerk

LAS:cl



RESOLUTION

(By Alderman Green)

...mmending the Corps of Engi... upon completion of a feasi... bility study has been carried by the Bassett Creek Watershed... and giving a favorable recom... mendation to higher authority ... the implementation of the plan.

Whereas, the United States ...my Corps of Engineers in co... ration with the Bassett Creek ...ood Control Commission, has ...mpleted a feasibility study for ...od control and related purposes ... the Bassett Creek Watershed in ...nnepin County, and

Whereas, said feasibility study ...s accomplished by authority of ... United States Congress at the ...quest of local interests; and

Whereas, the City of Minneapo... ... a member of the Bassett ...ek Flood Control Commission ...d was among the local interests ...questing the feasibility study. ...d

Whereas, the Minneapolis City ...uncil has by resolution adopted ...pt. 12, 1975 signified its intent... ...n to provide certain local as... ...rances required by Title II of ... United States Code if a feasi... ...le and acceptable project is de... ...loped and such assurances are ...quired; and

Whereas, the City of Minneapo... ...has been damaged by flood ...ters from Bassett Creek and ...ds protection against such ...oding; and the recommended ...n in the feasibility study if ...plemented, would provide such ...otection:

...w, Therefore Be It Resolved ...by the City Council of the City ...f Minneapolis:

That it commends the Corps of ...ineers and the Bassett Creek ...od Control Commission for ... ...letion of a practical and ...sible plan for the control of ...oding in the Bassett Creek ...atershed;

Be It Further Resolved that the ...rps of Engineers St. Paul Dis... ...ct is encouraged to make a ...vorable recommendation to ...gher authority on the feasibility ...port as a further step toward ...plementation of the plan; and

Be It Further Resolved that the ...ty Clerk shall be and hereby is ...rected to transmit three certi... ...d copies of this resolution to ...e District Engineer, Corps of ...gineers, United States Army, ...10 U. S. Post Office and Custom ...use, St. Paul, MN, and one ...py to the Bassett Creek Flood ...ntrol Commission.

Passed October 31, 1975. Louis ... DeMars, President of the ...uncil.

Approved November 6, 1975. Al... ...rt J. Hofstede, Mayor.

Attest: Lyall A. Schwarzkopf, ...ity Clerk.

STATE OF MINNESOTA)
County of Hennepin) ss.
CITY OF MINNEAPOLIS)

I, LYALL A. SCHWARZKOPF, City Clerk of Minneapolis in the County of Hennepin and State of Minnesota, do hereby certify that I have examined the attached copy of a resolution adopted by the City Council of said city at a regular meeting thereof held on the 31st day of October, 1975, and have carefully compared the same with the original thereof now on file in this office, and that said attached copy is a true and correct copy of said original and of the whole thereof.

In Witness Whereof, I have hereunto set my hand and affixed the corporate seal of said City this 10th day of November, A.D. 1975.

Lyall A. Schwarzkopf
City Clerk

[redacted]

CITY OF MIAMI

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Member Anderson introduced the following resolution and MOVED its adoption:

RESOLUTION
(Army Corps of Engineers
Flood Control Plan for
Bassett Creek)

WHEREAS, Bassett Creek has a major impact on the City of Golden Valley due to the fact that the greatest discharge from its tributaries occurs in Golden Valley, and

WHEREAS, Bassett Creek has been of major environmental and aesthetic importance to the City, and

WHEREAS, along with the benefit to the community have come the problems of periodic flooding, and

WHEREAS, the City has been a leader in seeking ways to resolve the problems of flooding on a multi-community basis through its support of the BCFCC, and

WHEREAS, the City, through its representative on the Commission, has participated in development of a plan to minimize the impact of the flooding while retaining the Creek as an environmental and aesthetic asset to the community, and

WHEREAS, the City Council, through Councilmember Rosemary Thorsen, has stated its public support for preparation of a plan to provide for flood control measures on Bassett Creek as long as certain matters of local concern are resolved in order to protect the interest of the City of Golden Valley and its citizens, and

WHEREAS, these matters are still of concern, and the District Engineer has given assurances that there will be further opportunities for resolution of these concerns before a final plan is adopted, and

WHEREAS, the City feels that Federal assistance in developing a flood control plan is a necessity due to the fact that action or inaction will affect potentially not only communities in Minnesota but also communities in other states farther down the Mississippi River;

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Golden Valley that:

1. The Army Corps of Engineers should pursue funding for the control of Bassett Creek;
2. General concept approval is given to the plan if, prior to approval of a construction plan, provision is made for further public hearings as requested at the 15 October 1975 hearing, and the matters of local concern resolved to this Council's satisfaction;
3. The Council wishes to thank the Army Corps of Engineers for its efforts to date in trying to develop a plan which will satisfy the desires of the communities affected.

Robert L. Hoover
Mayor

Attest:

Mary L. Draeke
City Clerk

The motion for the adoption of the foregoing resolution was seconded by Member Johnson and upon vote being taken thereon, the following members voted in favor thereof: Anderson, Hoover, Johnson and Thorsen, and the following voted against the same: none, whereupon said resolution was declared duly passed and adopted, signed by the Mayor and his signature attested by the City Clerk.

Phone: 537-8421

City of Crystal

4141 DOUGLAS DRIVE NORTH
CRYSTAL, MINNESOTA 55422

ADMINISTRATIVE OFFICE

December 17, 1975

TO WHOM IT MAY CONCERN:

Following is an extract of the minutes of the December 9, 1975 Special Council meeting:

Moved by Councilman Langsdorf and seconded by Councilman Rygg to adopt the following resolution, the reading of which has been dispensed with by unanimous consent:

RESOLUTION APPROVING PROPOSED PLAN OF THE BASSETT CREEK FLOOD CONTROL COMMISSION FOR FLOOD CONTROL.

WHEREAS, the City of Crystal is a member of the Bassett Creek Flood Control Commission and has participated in the development of the Commission's Flood Control Plan, and

WHEREAS, at a public hearing held on October 15, 1975, comments of members of the Commission and the public were presented regarding the proposed plan, and

WHEREAS, this Council, pursuant to action at its November 9, 1975 meeting, submitted further comments to the United States Army Corps of Engineers regarding said plan, and asked for responses from the Corps on the comments made, and

WHEREAS, the Corps of Engineers has adequately responded to the Council's comments and concerns in its letter dated December 9, 1975; and

WHEREAS, this Council has continuing concern about the ultimate financing of the projects embodied in the plan and its impact on the City, but recognizes that these matters are most appropriately dealt with within the framework of the Bassett Creek Flood Control Commission;

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Crystal, Minnesota:

1. It is hereby found and determined that the proposed plan for flood control developed by the Bassett Creek Flood Control Commission and the United States Army Corps of Engineers represents a sound and feasible approach to the flooding problems in the Bassett Creek Watershed.

2. It is further found and determined that this Council's concerns regarding certain elements of local costs with regard to the raising of roads and the termination of certain streets relate to matter of local determination. that final determination of the appropriate course of action on these matters need not be made at this time, but that the Council reserves the right to request future consideration of the possibility and costs of cul-de-sacs versus crossings and the raising of some streets.

3. The Council hereby approves the proposed flood control plan, recommending its approval by the Corps of Engineers for funding, and thanks the Corps of Engineers for the review of the questions posed.

By roll call and voting aye: Langsdorf, Bertrand, Rygg, Buchholz, Meintsma, McLaughlin; absent, not voting: Rosenthal. Motion carried, resolution declared adopted.

CERTIFICATION

I, Delores Ahmann, duly appointed and qualified Deputy City Clerk of the City of Crystal, do hereby certify that I have carefully compared the above copy of minutes of the Special meeting of the Crystal Council held on December 9, 1975 with the original thereof on file in my office and the same is a true and correct copy of said original minutes.

Witness my hand as such Deputy City Clerk and the corporate seal of said City of Crystal this 17th day of December, 1975.

Delores Ahmann
Deputy City Clerk

SEAL

city of SLP

[redacted]

October 27, 1975

Colonel Max W. Rush, District Engineer
Department of the Army
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Sir:

Re: Proposed Bassett Creek Flood General Plan

The City of St. Louis Park, along with eight other communities in the Bassett Creek Watershed, entered into a joint powers agreement in 1969 to form the Bassett Creek Flood Control Commission. The Commission provides the basis for cooperation between the nine member municipalities in the investigation, planning, and implementation of flood control measures. As a member of the Commission and one of the communities who must participate in any local funding of flood control measures, St. Louis Park feels it appropriate that it comment and make recommendations on any proposed flood control measures, and that those comments be incorporated into the official public hearing transcripts.

The preliminary draft of the feasibility report for flood control for the Bassett Creek Watershed has been thoroughly reviewed by the City's Environmental Improvement Commission. In addition, the City's Director of Public Works and engineering staff have reviewed and made recommendations to the City Council relative to the preliminary draft. The comments and recommendations of these groups were considered in the final position and recommendations adopted by the City Council.

[redacted]

[redacted]

[redacted]

[redacted]

RESOLUTION NO. 76 - 4752

RESOLUTION APPROVING PROPOSED PLAN OF THE BASSETT CREEK FLOOD CONTROL COMMISSION FOR FLOOD CONTROL.

WHEREAS, the City of Minnetonka is a member of the Bassett Creek Flood Control Commission and has participated in the development of the Commission's Flood Control Plan, and

WHEREAS, at a public hearing held on October 15, 1975, comments of members of the Commission and the public were presented regarding the proposed plan, and

WHEREAS, this Council has continuing concern about the ultimate financing of the projects embodied in the plan and its impact on the City, but recognizes that these matters are most appropriately dealt with within the framework of the Bassett Creek Flood Control Commission;

NOW THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF MINNETONKA, MINNESOTA.

1. It is hereby found and determined that the proposed plan for flood control developed by the Bassett Creek Flood Control Commission and the United States Army Corps of Engineers represents a sound and feasible approach to the flooding problems in the Bassett Creek Watershed.

2. The Council hereby approves the proposed flood control plan, including the funding proposed, as proposed by the U. S. Army Corps of Engineers.

Adopted by the City Council on this 2nd day of February, 1976.

Fred Hanus

FRED HANUS, PRESIDENT PRO TEM

Member Lange moved and Member Halverson seconded a motion that the following resolution be read and adopted this 26th day of January, 1976.

RESOLUTION NO. 2370

RESOLUTION APPROVING PROPOSED PLAN OF THE BASSETT CREEK FLOOD CONTROL COMMISSION FOR FLOOD CONTROL.

WHEREAS, the City of Robbinsdale is a member of the Bassett Creek Flood Control Commission and has participated in the development of the Commission's Flood Control Plan, and

WHEREAS, at a public hearing held on October 15, 1975, comments of members of the Commission and the public were presented regarding the proposed plan, and

WHEREAS, this Council has continuing concern about the ultimate financing of the projects embodied in the plan and its impact on the City, but recognizes that these matters are most appropriately dealt with within the framework of the Bassett Creek Flood Control Commission.

NOW, THEREFORE, BE IT RESOLVED by the City Council, of the City of Robbinsdale, Minnesota:

1. It is hereby found and determined that the proposed plan for flood control developed by the Bassett Creek Flood Control Commission and the United States Army Corps of Engineers represents a sound and feasible approach to the flooding problems in the Bassett Creek Watershed.

2. The Council hereby approves the proposed flood control plan, recommending its approval by the Corps of Engineers for funding, and thanks the Corps of Engineers for the review of the questions posed.

The question was on the adoption of the resolution and upon a vote being taken thereon the following voted in favor thereof: Lange, Briggs, Klick, Halverson, and Mayor McDonald.

and the following voted against the same: None.

WHEREUPON SAID RESOLUTION WAS DECLARED DULY PASSED AND ADOPTED THIS 26TH DAY OF JANUARY, 1976.

James H. McDonald, Mayor

ATTEST:

Eugene A. Hutton, City Clerk

RESOLUTION

A RESOLUTION APPROVING A PLAN OF THE BASSETT CREEK FLOOD CONTROL COMMISSION AND THE ARMY CORPS OF ENGINEERS FOR FLOOD CONTROL ON BASSETT CREEK

WHEREAS, in 1969, nine cities joined together under a joint powers agreement and organized the Bassett Creek Flood Control Commission, and

WHEREAS, the Bassett Creek Flood Control Commission has been meeting on a regular basis for the past seven years working toward our main objective, which is to prepare and implement an over-all plan for storing and/or conveying Bassett Creek's flood water to a properly developed outfall adequate to handle the drainage area, and

WHEREAS, this commission has spent substantial sums for engineering design and has conducted public meetings throughout the drainage area to obtain input from all persons who have an interest for any reason in the development of the creek, and

WHEREAS, this commission has requested of the United States Army Corps of Engineers assistance in preparing a flood control plan which could be constructed by the Corps with the majority of the monies coming from federal funds, and

WHEREAS, the United States Congress has approved appropriations to allow the Army Corps of Engineers to participate in the design of a flood control system, and

WHEREAS, a public hearing was held by this commission and the Army Corps of Engineers on October 15, 1975, and comments of the public and of governmental officials were accepted at that time and certain comments relating to the proposed plan have been discussed by this commission and responses have been submitted in writing to many of the parties who raised questions at the public hearing, and

WHEREAS, the proposed plan as approved will result in the federal government contributing in excess of $6,000,000 to the construction of flood control costs which will benefit all persons within the watershed district, and

WHEREAS, current projects being constructed in the City of Minneapolis by the Minnesota Highway Department with federal assistance results in an opportunity to establish the outfall conduit which is so desperately needed by all the communities within the watershed, and

WHEREAS, it is necessary that the Army Corps of Engineers and this commission act as expeditiously as possible to assure that an approved plan is processed by the Army Corps of Engineers and presented to the United States Congress at the earliest opportunity to insure savings to the public which will result from the joint action with the Highway Department in constructing a storm sewer tunnel throughout the City of Minneapolis.

NOW, THEREFORE, BE IT RESOLVED BY THE BASSETT CREEK FLOOD CONTROL COMMISSION:

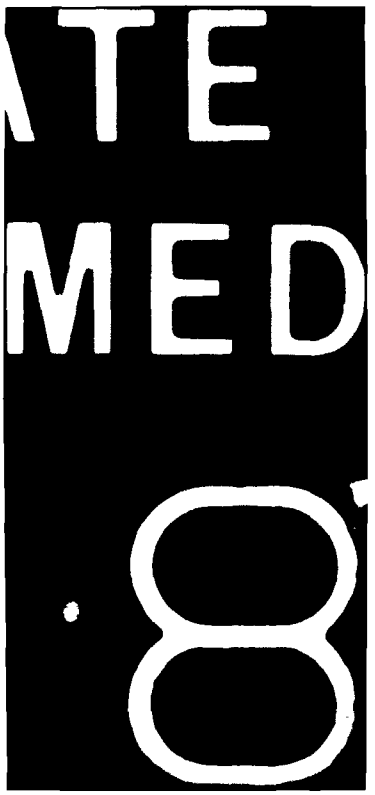
1. It is hereby found and determined that the proposed plan for flood control developed by the Bassett Creek Flood Control Commission and the United States Army Corps of Engineers as presented at a public hearing on October 15, 1975, and with amendments resulting from public and governmental comments be and is hereby approved as the soundest and most feasible approach available to the flooding problems within the Bassett Creek watershed.

2. This commission urges the United States Army Corps of Engineers to proceed as rapidly as possible to submit the proposed plan to the Division Engineer and to take whatever other steps are necessary to assure prompt approval and joint construction with the Minnesota State Highway Department of the underground tunnel in Minneapolis.

3. The Chairman and Executive Committee in conjunction with the commission's engineer and attorney are authorized and directed to work with the United States Army Corps of Engineers for approval of the plan and for funding.

Adopted this 19th day of February, 1976.

Richard J. O'Neill
Chairman


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